AVIATION

PRATT & WHITNEY POWERS NEW CURTISS

"Troopships of the Sky"

"There's *One* light nobody's going to blackout"

● Lads in khaki flying blouses and factory men in work shirts are not voluble in gushing sentimentalisms but in their American hearts is a silent resolve far more potent than the high pitched shrieking or jaw-jutting bombast of dictators.

Many of the 13,000 men of Thompson Products are of foreign extraction. Many of them stood at ship's rail and thrilled as they saw the symbol of liberty loom out of harbor mist. These men now have a deeper sense of what the high-held torch stands for. Here at Thompson, with their American-born fellow workmen, they are making the parts for the planes that their sons are flying. Together they will help build and man a canopy of sheltering wings to defend and preserve the things for which the symbol on Bedloe Island stands.

Thompson Products plants are working three eight-hour shifts a day, seven days a week, producing aircraft engine and airplane parts. Over 900,000 square feet of floor space have been added to Thompson Products manufacturing facilities. The working force has been expanded to 13,000 employees. Output is being increased six times over any previous peak period. There is a job to be done!

THOMPSON PRODUCTS, INC.

Cleveland • Detroit • Los Angeles

Subsidiaries: Toledo • St. Catharines, Ont.

Manufacturers of over 1000 different aircraft engine and airplane parts, and original and replacement parts for the automotive industry. A pioneer of the sodium cooled aircraft engine valve.

Thompson Products

AVIATION

NUMBER 6 VOLUME 41

JUNE, 1942

REGULAR EDITION

Contents

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Acting Managing Editor
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Financial Editors
Selig Altschul.....Raymond Hoadley

★ ★ ★

On Leave of Absence With Government Services
Carl Norcross.....*Captain, Air Forces*
Charles F. McReynolds..*Lieut., Air Forces*
Jay P. AuWerter.....*Lieut., Air Forces*
Kenneth D. Reynolds.....*Lieut., Infantry*
Don Fink.....*Special Assignment*

In This Issue 5
Editorial Page 71
AVIATION's War Communique No. 6 72
Women in Slacks Speed Plane Production ..... Don Wharton 74
Tactics and Unorthodox Aircraft ..... Major Oliver Stewart 76
Italian Aircraft 78

Aviation Manufacturing

Production-Design-Research-Engineering ..... Complete Index 81
Forming-By-Drawing ..... Frohman Anderson 82
Mass Producing the A-20 Bombers ..... John D. Weaver 86
Efficient Machine Loading ..... Max Stupar 94
Improved Solutions of Remote Control Problems ..... Herbert Chase 97
Working Transparent Plastics, II ..... John Sasso 105
Production Boosters at Fleetwings ..... Perry Anderson 111
Forged Cylinder Head Developed by Wright 117
Perspective Drawings Speed Plane Assembly 118
American Mathematical Society Meets ..... Dr. Arthur Korn 121
Review of Patents 124
AVIATION's Sketch Book of Design Detail 126
Subcontractor's Section 165

New Products

New Products and Equipment for the Aviation Industry
Modern Machine Tools 137
Shop Equipment and Accessories 147
Window Shopping 163

Military

Flying Tank Busters ..... J. I. Waddington 191
The Army Goes Afloat 193
Timm Trainer Undergoing Navy Tests 193

Maintenance

Service Problems Of Aircraft Engine Exhaust Systems
Jack C. Zippwald 175
Air Hammer Test Stand 186
Training the Customers 186
AAF to Factory Schools 186

Air Transport

Instrument Landing Systems Will Aid War Effort ..... A. C. Preil 197
Kansas City's Airport System ..... Wilson W. Brown 201

Flying Equipment

Merlin "Twenty" 207
New Fairchild Cornell 209

Civil Operation and Training

Inter-American Escadrille Assumes War Role ..... John Foster, Jr. 213
CAA Trains for Overseas Work 217
On Patrol 217
Along the Apron 218

Side Slips 171
Aviation's Management Responsibility ..... Selig Altschul 172
AVIATION's Radio Page ..... W. W. MacDonald 189

The Aviation News

National Aviation 221
Washington Windsock 225
Aviation Manufacturing 226
Assembly Lines 230
Aviation Abroad 233
Transport Aviation 238
Finance....*By Raymond Hoadley*...241
Aviation People 245
Book Reviews 247

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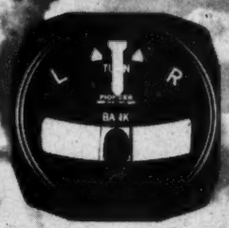
Aviation is indexed in Guide to Periodical Literature and in Industrial Arts index.

FOR VICTORY!

—his eyes must be sharp as his claws

Pioneer Sensitive Altimeter

Pioneer Air Speed Indicator



Pioneer Turn and Bank Indicator

Pioneer Sensitive Rate-of-Climb Indicator

Pioneer Remote Indicating Magnesyn Compass

INSTRUMENTS of utmost sensitivity and reliability are necessary to gain maximum effectiveness from an airplane's range, speed and fire-power. A split-second advantage can be priceless. Implicit confidence can snatch Victory from defeat. The keen realization of these truths by Pioneer craftsmen has made and has kept the precision standards of Pioneer Aircraft Instruments extremely high.

Pioneer INSTRUMENT

DIVISION OF BENDIX AVIATION CORPORATION

BENDIX, NEW JERSEY, U. S. A.

★ ★ ★ ★ ★ IN THIS ISSUE ★ ★

Chidnoff Photo

DON WHARTON traveled 10,000 miles visiting aircraft plants from coast to coast, to get the facts and figures for his story on how women in slacks are speeding plane production. Hailed from North Carolina originally, worked on southern papers and finally wound up in the big city on the "New York Herald Tribune." Then he switched to magazines—"Outlook," "New Yorker," "Scribner's"—and has been writing for them ever since.

ONE OF THE MAIN IDEAS underlying our participation in this war is that the Democracies are to lead the world out of chaos and insecurity. As a nation, we are now working pretty hard on the immediate objective of winning the war, but the plain truth of the matter is that a great many people are dreading to think about what is to come afterwards.

There are vague fears of dangerous post-war readjustments. People have visions of demobilization of armies, shutdowns in industry, unemployment, deflation, bankruptcy and hard times.

A much greater truth, however, is this: If appropriate action is taken, there is no need for a post-war slump.

No country is impoverished if its productive resources are intact and utilized with some degree of efficiency. After this war is over, we shall have the productive capacity, technical equipment, trained manpower and natural resources sufficient to produce a higher standard of living and a greater national income than ever before achieved in history.

As one of the nation's largest single industries, outside of the war machine itself, the obligations of the aviation industry with respect to the planning and administration of post-war conversion to peace is of the highest order—by the same token, the penalties we can pay for any shortcomings in this respect are proportionately fearful to contemplate.

It is never too early to plan, says the editor (page 71), least of all now, for what profit will there be in leading the world out of chaos and insecurity only to sink into the destructive maelstrom of our own neglect and shortsightedness?

The first published account of a revolutionary new process for forming sheet metals begins on page 82. Called the "Forming-by-Drawing" process by its inventor, Mr. Frohman Anderson, it not only efficiently forms skin sections with difficult compound curvatures, but conserves metal and eliminates much of the time and machinery required by other methods commonly used for the same purpose.

MAX STUPAR, coordinator of production at Bell Aircraft Corp., is one of the industry's real old-timers, with nearly 40 years of active interest and participation in aeronautics. Proof that his ideas still express youthful vigour and originality, however, is contained in his article (page 94) describing the machine loading control board system set up at Bell Aircraft. As early as 1905, Mr. Stupar had begun serious aviation experiments, and by 1910 had built his first successful airplane. Later, he was with the Curtiss-Wright organization for many years and in 1940 resigned to affiliate with Bell.

THIS IS A WANT AD

If you are—

a licensed pilot between 21 and 42, have over 140 solo hours logged, can meet physical requirements for Commercial Pilot's Certificate, and aren't directly engaged in war work —but want to be—

See story on page 217!

In this issue is told the production story of one of America's most successful warplanes, the Douglas A-20 light bomber. The British use it successfully in two versions: the *Boston* as a high performance medium bomber and the *Havoc* as a deadly night fighter.

The story of the remarkable new method of machining cooling fins and ports on forgings to make a lighter, stronger and more efficient cylinder head, as developed by Wright Aeronautical Corp. after five years of intensive research, is told on page 117.

In the Maintenance Section, beginning on page 175, is a complete discussion of service problems on aircraft engine exhaust systems.

Coming

The July War Production number of AVIATION is focused on one objective—to create the planes faster that will win the war quicker. Only a few high lights can be mentioned in the space available, but we can promise that its articles will contain constructive material of value to almost everyone engaged in any phase of the productive effort of the industry.

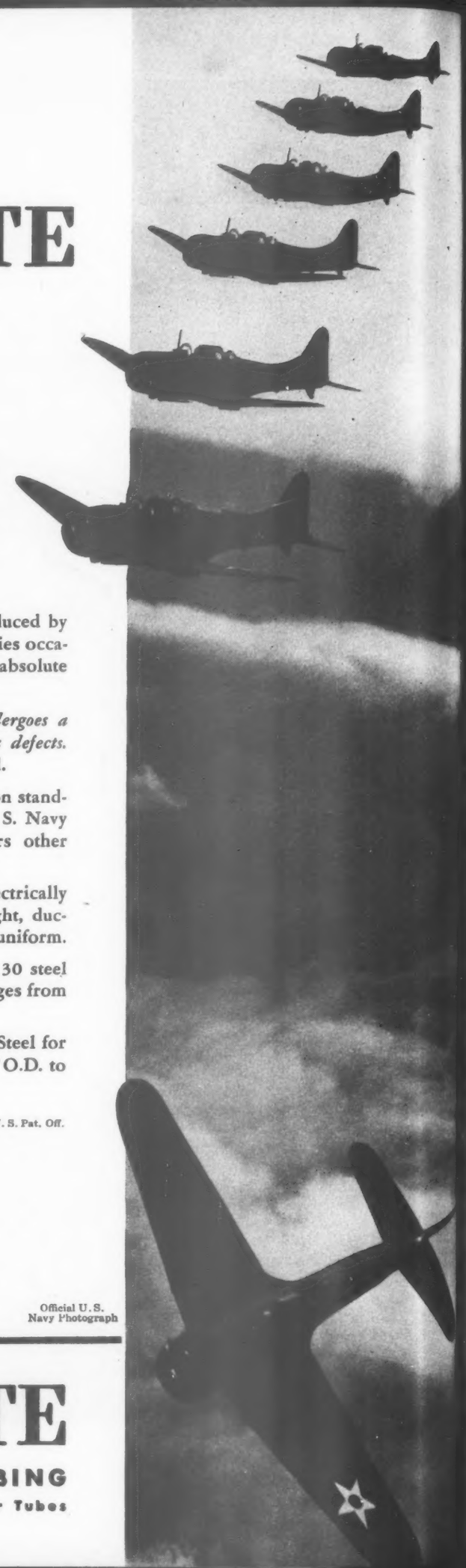
A production control story tells how one of the largest airplane manufacturers called upon the largest business machine company to set up a card system which translates a blueprint into assembly records. The system developed cuts a former six-weeks operation down to one and a half days.

Another article will describe the methods employed to produce what a ranking officer of the Air Forces describes as the world's "No. 1 Fighter."

There will be many other production features on airframes, aircraft engines, accessories and equipment plus AVIATION's regular departments.

Why ELECTRUNITE *Tubing*

IS *ABSOLUTELY* FREE FROM HIDDEN DEFECTS



Even though Republic ELECTRUNITE Aircraft Tubing is produced by a fully-mechanical process that eliminates most of the uncertainties occasioned by the human element, every precaution is taken to assure absolute freedom from possible hidden defects.

Every length of Republic ELECTRUNITE Aircraft Tubing undergoes a specially-developed non-destructive electric test to detect injurious defects. Any length which does not pass this test is immediately rejected.

This electric resistance welded tubing—which meets specification standards of the U. S. Army Air Corps; Bureau of Aeronautics, U. S. Navy Department; and the Civil Aeronautics Administration—offers other advantages.

Because it is cold-formed from flat-rolled steel and then electrically welded, diameter, wall thickness, concentricity, strength, weight, ductility, hardness, weldability and scale-free surface are consistently uniform.

Republic ELECTRUNITE Aircraft Tubing made of S.A.E. X-4130 steel is available in sizes from 3/8″ O.D. to 1 5/8″ O.D., inclusive, in gauges from .028″ to .065″.

Republic ELECTRUNITE Tubing made of ENDURO* Stainless Steel for aircraft use is available in standard analyses in sizes from 3/8″ O.D. to 3″ O.D., in gauges from .025″ to .120″.

Write for complete details on your needs.

*Reg. U. S. Pat. Off.

STEEL AND TUBES DIVISION
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REPUBLIC STEEL — PRODUCTION FOR VICTORY

Republic

Official U. S. Navy Photograph

ELECTRUNITE

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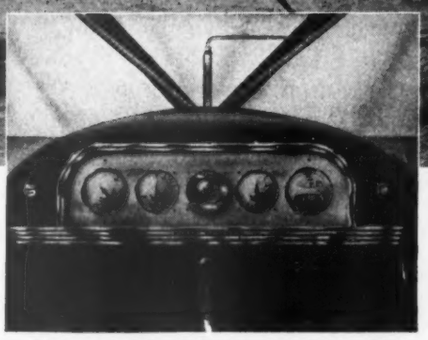
ELECTRIC RESISTANCE WELDED TUBING

Also Boiler Tubes • • • Condenser and Heat Exchanger Tubes

AN ALL-AMERICAN AIRPLANE TO SERVE THE FLYING NEEDS OF AMERICA AT WAR



QUICK-READING NEW INSTRUMENT PANEL

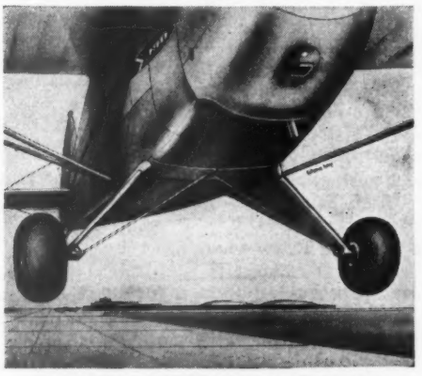
100-HORSEPOWER

PIPER

Super Cruiser

- ✓ FOR PATROL FLYING
- ✓ FOR INSTRUMENT INSTRUCTION
- ✓ FOR PILOT TRAINING

Civilian aviation needed an all-purpose airplane like this new three-place Piper Super Cruiser! It cruises at 100 miles per hour. Its wide cruising range ideally suits the needs of Civil Air Patrol flying. The interior arrangement and unusually large payload make the Piper Super Cruiser an excellent instrument trainer when blind flight instruments are installed. And with dual controls in place it becomes a tandem-seating pilot trainer. Every CPT school and every flight operator will find a multitude of uses for a Piper Super Cruiser. See your Piper Dealer for full particulars and a free flight demonstration.



EFFICIENT STREAMLINED LANDING GEAR

FREE CATALOG

showing all the new Piper planes may be obtained from your Piper Dealer. Or, if you wish, we will gladly mail you one of these handsome, deluxe catalogs which portrays all the Piper planes in full natural color, providing you enclose 10c in stamps or coin for postage-handling. Piper Aircraft Corporation, Dept. A62, Lock Haven, Pennsylvania.

PIPER POINTS THE WAY TO WINGS FOR ALL AMERICA

The Birdmen's Perch

ATTENTION PERCH PILOTS: We wish you could see the letterhead on which Tom Mathews wrote his Whopper. It shows a squawking baby bird emerging from an egg which is initialed "SB." The egg is flanked by a pair of *inverted* wings and the whole get-up is one of the funniest things we've ever seen.

Major Al Williams, alias, "Tattered Wing Tips," Gulf Aviation Products Manager, Gulf Building, Pittsburgh, Pa.

• • •

This month we flap our tattered wing tips in welcome to the biggest group of potential Perch Pilots in the country.

We mean the squadrons of the Air Training Corps of America already formed, and the hundreds of new ones which will be in operation by autumn.

The ATCA offers complete basic pre-flight courses to high school juniors and seniors who wish to take them. Many New York schools have begun the courses already and other schools all over the country are registering interest.

Working closely with the CAA, and sponsored by the nation's top education and aviation men, the ATCA will fill in much of the gap between walking and flying. Their goal is to get 2,000,000 potential airmen enrolled by 1943—great news for Uncle Sam and tough news for the HiroHitMuss crowd.

From now on, Perch Fledgings, you have a 50 percent interest in this page. We'll print your Funnyboners if they're funny, your puzzles if they're puzzling.

And if you can earn it, we'll send you the finishing touch—the last straw—in any aeronautical education, a Birdmen's Perch Whopper Diploma! **T. W. T.**

THIS MONTH'S BRAIN TWISTER

A lad we know recovered part of a wing last week. He removed the old fabric from the wing and bought two new pieces,

one 2 feet longer and 1 foot narrower than the old piece; the other 5 feet longer and 2 feet narrower than the old piece. All covered the same space.

What were the dimensions of the old fabric?

(The dimensions of a postcard are 5½" x 3¼". Send us one and we'll give you the answer.)

A FURTHER FOR OUR CAP

At present, fighter aircraft provide protection for bombers on only the shortest missions.

That's because fighters are *fast!*

A fast plane has stubby wings . . . which means high wing loading . . . which means low fuel capacity . . . which means limited range.

A plane which will lick this problem has already been mocked-up and stress analyzed. It will "go all the way" with bombers, furnish pursuit protection while they unload, then bring them home.

The designer went after high performance characteristics with this job—but he went further than that.

He went after a range of 3,500 miles!

His work furnishes a swell example of the thinking we did when we "designed" Gulfpride.

We bought choice crudes and refined them into oils of high quality—but we went further than that.

We developed a whole new technique, the Alchlor Process, which got more of the carbon makers and more of the sludge formers out of this already refined oil! *It went further.*

That's why Gulfpride goes *further.*

THIS MONTH'S WHOPPER

Dear Mr. Williams,

We've been grounded out here. I do my cross-country by gas-buggy, now.

Recently I was crossing an unnamed dry-wash in an unnamed desert when a sentry jumped out of a bush and told me to come along and show my credentials to his CO.

I flashed my "Whopper" Diploma (I always carry my Diploma and a small bottle of Gulf Aviation Gas in memory of the old days) and logbook on the CO, who promptly begged me for some advice.

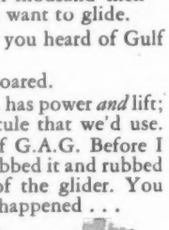
They were running load tests on a glider built to carry maybe ten thousand men—maybe not—and it didn't want to glide.

"CO," I said, "haven't you heard of Gulf Aviation Gas?"

"This is a glider!" he roared.

I explained that G.A.G. has power *and* lift; that it was the lift molecule that we'd use.

I got out my bottle of G.A.G. Before I could explain, the CO grabbed it and rubbed it all into the fuselage of the glider. You boys at Gulf know what happened . . .



The glider with maybe ten thousand men—maybe not—floated lazily out of sight. I turned to the CO just too late. He'd spilled a drop or two of G.A.G. on his sleeve and was drifting after his men.

I've expected to hear of our boys dropping out of the sky and mopping up some stubborn spot out East. But in vain.

Guess our boys are still up there.

Tom Mathews

Grand Imperial Dodo, Mother Nest Chapter, Squawking Birdmen, Monterey, Cal.

Gulf Oil Corporation and Gulf Refining Company . . . makers of

GULF AVIATION PRODUCTS

OIL IS AMMUNITION — USE IT WISELY !

TUNE IN "WE THE PEOPLE" AT WAR. SUNDAY NIGHT 7:30 EWT COLUMBIA NETWORK

Someday the War Will End

"THIS WILL BE A LONG WAR AND A HARD WAR" said the President of the United States in a recent talk. He was right. In the first few months of its inauspicious beginning we have spent more money than the cost of the entire bill for participation in that highly localized conflict miscalled the World War. We have suffered greater losses in naval personnel than the total for the previous history of our Navy. We have passed through an almost unbroken series of reverses and our most brilliant performances necessarily have been delaying actions.

In spite of all this there is not one among us who even entertains a thought of anything but final victory. Our chief problems are concerned with attainment of that victory in the shortest possible time with the least amount of unnecessary bloodshed.

On the home front there is much tangible cause for encouragement. Material shortages and unfriendly priorities have failed to stem the rising tide of aircraft production. We have reached the point where you can stand for a few minutes at the end of assembly lines and actually see planes move out into the sunshine—a brief test flight and on they go for destinations unknown. It is true that there are many places to send them on all the continents but at last they are beginning to accumulate in these places and already their presence is being felt by our enemies. And with all this we are now on the threshold of even greater manufacturing miracles.

Our successes in the battle of production have not been gained without headaches and heartaches, and there are more of them to come. Even as this is written there are many plants unable to operate at the fullness of their newly created capacity because of lack of certain materials. Some of these manufacturers are gravely concerned about the morale of their workers because of production slowdowns due to shortages. Some are facing the possibility of layoffs, and when you lay off men in these times, they don't wait around for you to take them on again. It would be well for those among our leaders who are concerned with priorities to consider these facts carefully if they wish the aircraft industry to continue to perform miracles.

In certain areas it is not unlikely that transportation of workers may emerge as the most serious of all bottlenecks. This problem will not be satisfactorily solved by such spectacular expedients as barracks for workers or 150 passenger war model buses. In the first place, you can't jounce people around in uncomfortable vehicles and expect them to perform at their top efficiency in precision manufacturing work. In the second place, the large capacity vehicle defeats its own purpose because it requires the use of a common loading point some distance from the workers' homes. The only satisfactory solution of the problem will be found in the use of some smaller type vehicle which will provide greater flexibility and less retraced travel mileage between workers' homes and the factories.

Although these problems are pressing, there are others equally serious and there will be others at present unforeseen. But there is one that can be foreseen, and that is being sorely neglected in the thinking of too many of us. It is the problem of post war readjustment.

Some of us have felt that total war means total concentration on present problems and that philosophy is laudable. Some of us have feared the criticism of our military leaders if we dared to think of anything beyond winning the war. But the final victory will be hollow indeed if we are not prepared to assume the tremendous responsibility of reconstruction. The devastation wrought by this present conflict will be far greater and will reach farther than that of any of the 800 major conflicts of recorded history. But after the world has been torn asunder we must carry on. It is an important part of patriotism to do some thinking now about the future. This is the duty of every man and woman enengaged in any phase of the war effort, be it civil or military. If we do not set aside a portion of our thinking now for post war planning we will be faced with a future calamity that will make this terrible war seem mild by comparison.

Leslie E. Neville

AMERICA AT WAR

"We are not going to lose Australia," promises Brett, as the Jap is slowed in his push to the South. Meanwhile, antipodal forces of the United Nations pulverize Nazi arms plants in RAF blasts at the Continent.

LIEUT.-GEN. GEORGE H. BRETT, United Nations Air force Commander in Australia, says that Australia may have to take a little drubbing from the Japanese but "we are not going to lose this country."

American and Australian planes are in the air all the time looking for Japanese, says John McEwen, former Australian Minister for Air.

Signs are even more definite now than they were when your last Communique was written that Japanese air and surface forces have been slowed if not completely stopped on the margin of North Australia. There is no longer any expression of fear of loss of that big island, in Washington or elsewhere.

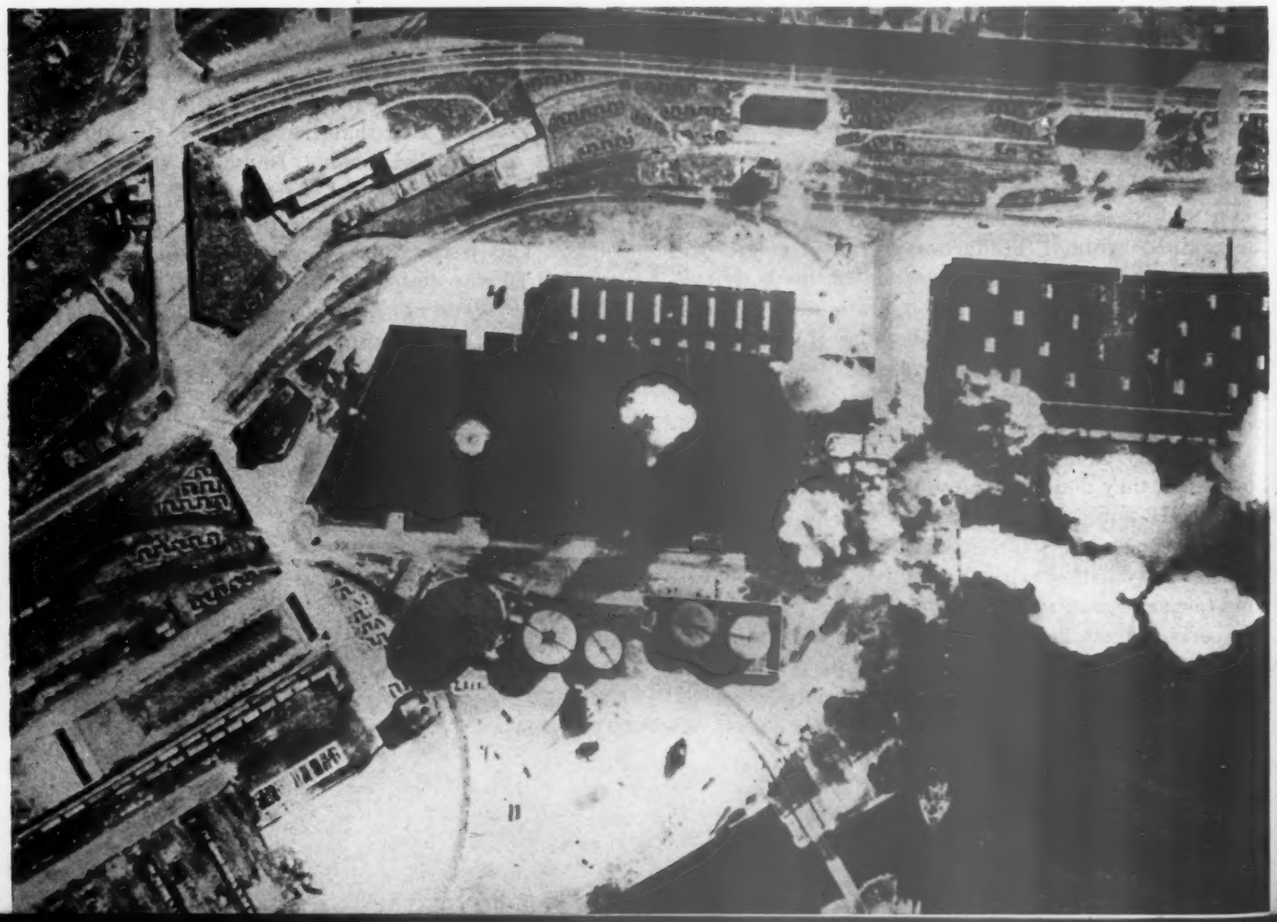
From now on the front line will move northward instead of southward. How soon, and how fast, will depend, as General Marshall said, on our getting sufficient forces there to seize and hold islands. It is a war of islands—a war on land, sea and air for islands.

General Brett gave what may be a fair estimate of the quality of Japanese airplanes when he said that 100 American planes are worth 200 Japanese planes. This is taken not merely as a boastful remark but as a considered observation. Even at that, if we have to put up 100 airplanes for every 200, seven or eight thousand miles away from home, it's no small chore.

Most observers are mildly surprised at the showing the

This unusual shot caught British bombs bursting on docks and buildings at the height of a recent daylight raid on Le Havre, German base in occupied France. Note system of bomb shelter trenches surrounding the central dock.

Wide World Photo



Japanese are making in the air. When you consider that the little yellow men have scarcely any technical creative power, never having invented anything in the whole gamut from egg beaters to superchargers, you must admit they are doing a first rate job of adapting other people's aero development work to their needs and their ambitions.

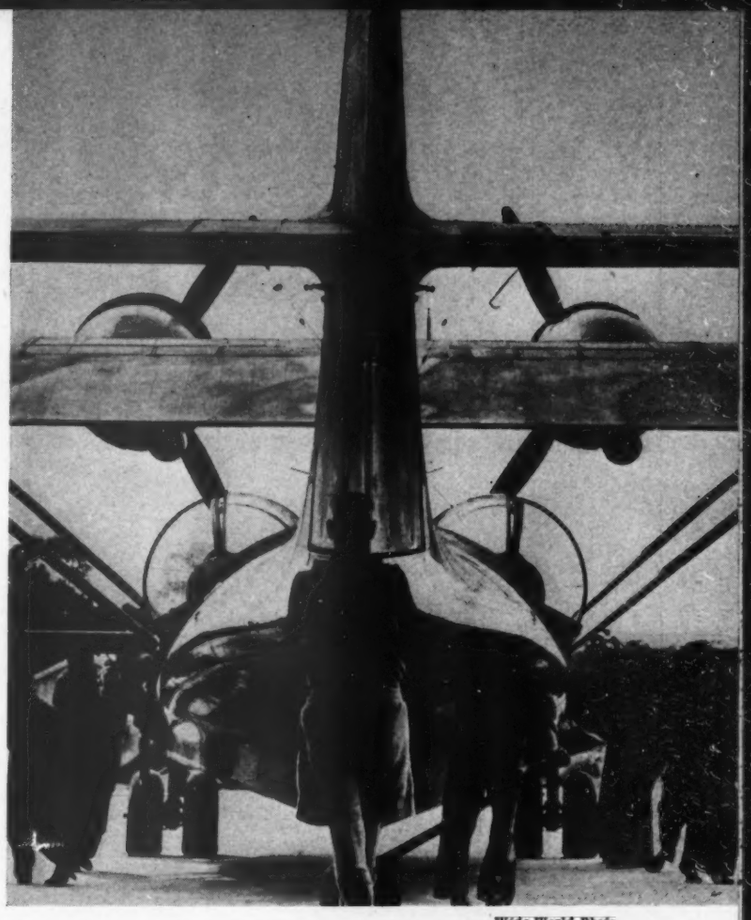
Incidentally, in the absence of any official report on the number of Nipponese airplanes, one man turns up, writing in the British *Manchester Guardian,* with an earnest attempt to show that Rising Sun production is somewhere between 12,000 and 16,000 a year, rather than about 5,000, as most every one assumes. His argument is not very convincing.

Still more about the Japanese aloft: the *Army and Navy Journal* says it has reports that Japanese army fliers are inferior to naval fliers. Most of the enemy bombers are of the two-engine type, with a medium ceiling. The new-type bombers are still inferior to similar type American planes. Dive bombers were none too effective as pilots usually hesitated to approach within 10,000 ft. of the target. Virtually all Japanese fighter planes are inferior to American planes.

Still on the war in the East, it begins to look as if the historian, trying to highlight 1941 in the Second World War, will put down among top events the sinking of the British *Repulse* and *Renown* battleships by Japanese air forces. This fact may already have turned the development of heavy war ships at a pretty sharp angle. The United States Navy has not said whether or not it is laying down any more battleships.

Which moves us over to Europe and Britain's announcement that the German battleships *Gneisenau, Scharnhorst* and the heavy cruiser *Prinz Eugen,* have been hunted down with air cameras, and discovered to be badly damaged and definitely out of Hitler's spring push. This seems to confirm reports of RAF and the Fleet Air Arm that their planes and ships were attacking in very low visibility—so

(*Turn to page* 260)

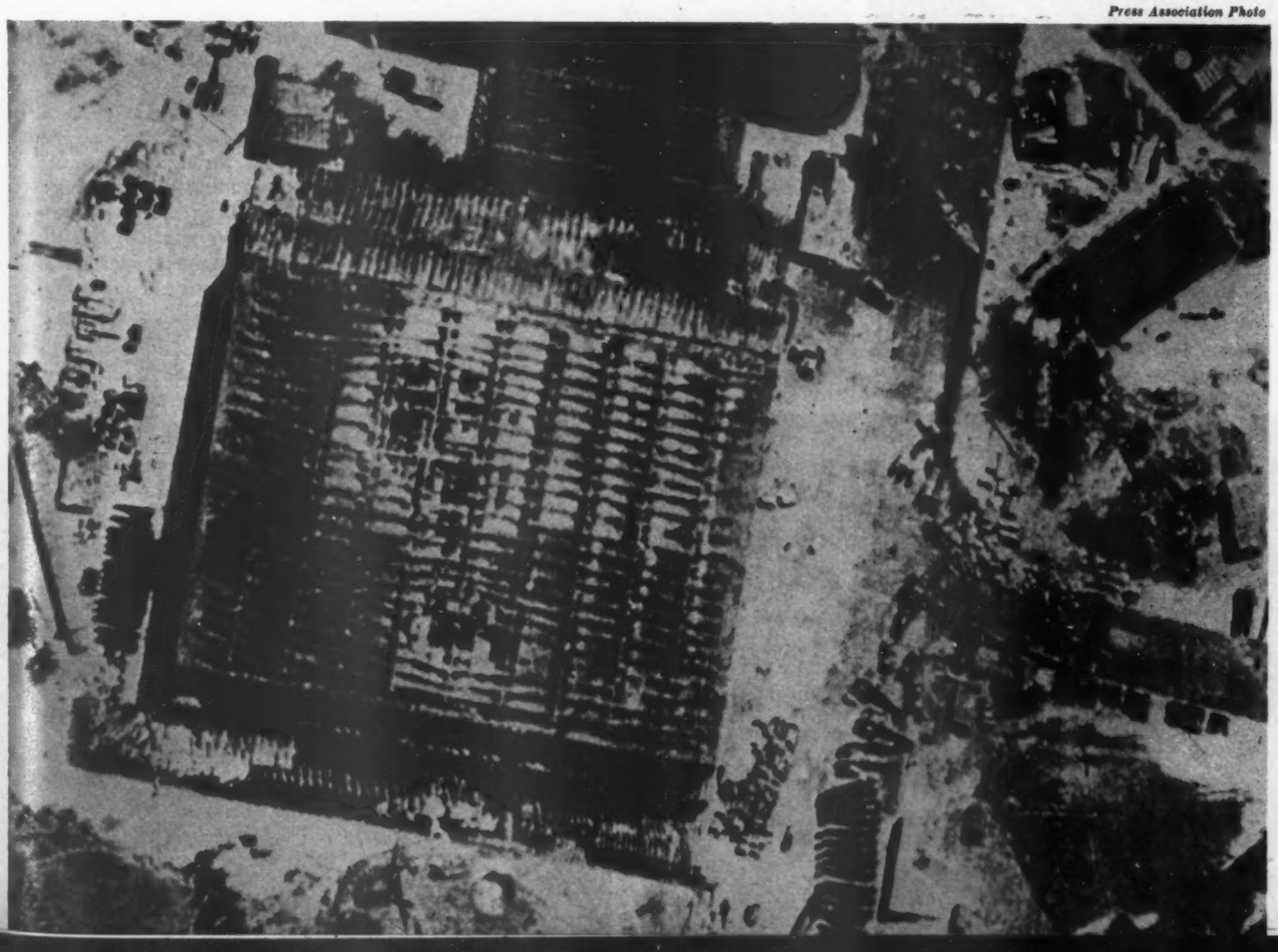


Wide World Photo

Planes like this U. S.-made Consolidated "Catalina" patrol boat are in the air constantly guarding Australia's coastline and looking for the Jap. Ground crewmen of the Australian Air Force are beaching a "Catalina" after a patrol flight.

After four successive nights of devastating raids by the RAF, the Heinkel plant at the German Baltic port of Rostock presented this bleak aspect in a photo just cabled from London. Gaping holes in the factory roof and wreckage of planes are clearly discernible.

Press Association Photo



Women in Slacks Speed Plane Production

No longer is their doubt that women can "take it" in our factories. Aviation's experience proves they are actually increasing the output in the greatest production effort the world has known.

By DON WHARTON

Wide World Photo

These all-girl drilling and riveting teams, now training, soon will take their places on the assembly lines of Ford's huge Willow Run bomber plant.

OUR 1942 production goals call for 10,000,000 workers in war factories in addition to 5,000,000 already employed, according to Sidney Hillman, labor director of the War Production Board. This means that millions of women must help to "man" the assembly lines.

How will America's women respond to this call? How well will they do their part toward keeping America free? The achievements of women in coveralls in the aviation industry give a typical and inspiring answer. While Washington has been talking about registering women, our aircraft plants have put them to work in essential jobs.

Not much more than a year ago, there were no women in our aircraft plants, except for a few seamstresses and inspectors. Even as late as Pearl Harbor the industry employed only a few hundred women. Today Glenn Martin is hiring more of them per month to make bombers than the entire industry had hired up to December 7. Consolidated has 2,500 women reporting for work every day—and no *Liberator* or *Coronado* leaves San Diego to bomb the Axis but has been partly fashioned by a woman's hand. Altogether the industry has more than 15,000 women in coveralls. By June that figure will probably be tripled. By the year's end it is expected to reach 100,000—and keep on rising. From coast to coast, women are working on every type of plane from light trainers to the heaviest four-engine bomber.

This little industrial revolution began in Los Angeles where Vultee makes trainers and pursuit ships. Early in 1941—months before OPM asked aircraft plants to experiment with women workers—Vultee hired 25, put them to work on electrical and radio sub-assembly, attaching wires and fitting out junction boxes. These pioneers were scheduled to start work on April 1 but the prejudice against women was so strong that the management had them report on March 31 in order to prevent cracks about April Fool's Day. In three weeks the Vultee experiment proved a success: units produced per week had increased, some going up 25 per cent, some even 50 percent. In addition, the women had inspired men to increase their output to keep pace.

Vultee then began hiring more women, spreading them through the plant; in machine shops, filing and burring; on drill presses, milling machines, cut-out saws. Where the work is repetitive foremen invariably report increased effi-

Women have long played a large part in actual production work on training planes at Piper Aircraft Corp.'s plant in Lock Haven, Pa.

Acme Photo

Vultee girls put the finishing touches on canopies in the paint shop. Women prove better than men at certain jobs.

Dick Whittington Photo

Picture-charts devised by Vega engineers to aid new women workers on Flying "Fortress" electrical assembly line have helped triple output of such items as junction boxes, electrical control, bomber control and instrument panels.

ABOVE RIGHT: shows Joycille Peterson, after only one week at plant, at first of four steps in this assembly, installing box and elbow fittings on engine junction box, aided by explanatory chart at lower right. The durable charts are pasted on plywood and shellacked. ABOVE LEFT: shows Verita Van de Car at another assembly post following chart as she installs support bracket to engine junction box assembly. Through use of such charts inexperienced but nimble-fingered women have been able to quickly perform many operations faster than experienced men. LEFT: shows Doris J. Jones at final post, adding accessories and tightening panels and fittings. Guide-chart is shown below completed engine junction box ready for installation.

ciency. One points to a girl pulling a mass of wires through a long tight tube —in 15 min. against her male predecessor's half-hour. Another foreman shows you a woman fitting 63 different wires into a junction box little larger than a handbag—women workers have cut that time from two hours down to 90 min. Vultee was the first company to use a powered conveyor assembly line. A fuselage frame starts down this line, passes stations at which girls install throttles, controls, instrument panels and so on. It begins as a bare, skeleton-like frame and emerges a completed fuselage, ready to be attached to tail and wings—and nowhere en route does a man touch it.

In the past few months Vultee's experience has been matched by plant after plant. At Vega's attack bomber factory, one foreman with 20 percent of his crew women was asked what percentage he considered ideal for his department. "One hundred percent," he said. Many foremen who resisted the placing of women in their departments are now begging for more. "Where weight and fatigue are not factors," one told me, "women are as good as men."

Virtually every aircraft plant has efficient women riveting teams — one riveting, the other bucking. Glenn Martin made exhaustive tests in light rivet teams, trying a man riveter with a woman bucker, a woman riveter with a man bucker, and a woman riveter with a woman bucker. All combinations worked. When North American substituted women for men in the tubing department production went up 20 percent. One of the women has a child at home and a husband in the Navy. She operates a bending machine which used to be a bottleneck. "Now," her foreman says, "she's bending faster than the trimmers can take it." At North American's Dallas plant a girl who used to work in a beauty parlor feeds 8,000 metal clips a day into a machine—2,000 more than men had averaged.

At Northrop, which has hired 400 women in 50 days, there was one job only two men in the plant could do. For a year the foreman tried to break in a third. He couldn't find anyone who had the knack until he tried a woman. She mastered it in a week. At Lockheed some departments use girls as shock troops—when a man begins slowing down a girl is put in next to him. Invariably he's spurred on.

(*Turn to page 249*)

Tactics and Unorthodox Aircraft

Britain relies mainly on conventional design for the bulk of her military aircraft strength. However, certain tactical innovations have been made possible with telling results upon adoption of unorthodox design features.

By MAJOR OLIVER STEWART
Editor of "Aeronautics"

Air Ministry Photo

Wide World Photo

***Above:** A four-gun power operated turret on this Boulton Paul "Defiant" is one of the unorthodox design features initiated by the British resulting in immediate tactical advantage. Unsuspecting Nazis were blown out of the air when these planes drew alongside and cut loose from the side.*

***Left:** The Westland "Lysander" liaison plane is ideal for observation work with its very slow safe flying speed. It is equipped for supply dropping, photography, radio reporting, and even bombing. Its remarkable flexibility is indicated by a top speed of 229 mph.*

UNCONVENTIONAL aircraft designs do not often succeed in war. The amazing invention which appears so often in fiction and which—in fiction—wins so many wars seems to have no counterpart in real life. In aviation especially it is usually the orthodox well-developed aeroplane that proves the best in service. An example is the Armstrong Whitworth *Whitley*, a bombing aeroplane of perfectly normal conventional design built by conventional methods. At the outbreak of war in September 1939, the *Whitley* was looked upon by many people as obsolescent if not obsolete. Yet a year later it was one of the mainstays of the British bombing fleet.

The *Whitley* was given a fresh lease of life by being slightly modified and re-engined and in this form it proved completely successful and showed itself capable of operating under difficult conditions.

Britain Was First With Power-Operated Turrets

But although a conventional areoplane appropriately developed and modified seems usually to play the leading part in war there are occasions when unorthodox designs or constructional methods or novel equipment comes into service with surprisingly successful results.

If the operations of the Royal Air Force are studied, it will be seen that they owe their successes mainly to steady development of aircraft and aircraft equipment, but also to some extent to strikingly original thinking and to the introduction of unorthodox features.

The power-operated gun turret, which has been since the beginning, a feature of the big British aircraft, and which is fitted to not only the heavy bombers but also to the medium bombers, is an example of a bold unconventional piece of design work.

No other country in the world thought it possible to introduce a power-operated turret. But British designers went forward with this component, developed it both for electrical operation and for hydraulic operation, and finally brought it to the stage of full efficiency.

At first many different theories were held about the method of operating such turrets, and one of the early Boulton Paul turrets was so arranged that the entire working of the rotatable part was brought about simply by the action of the gunner in aiming his gun. Thus, by swinging the gun to the right, power would be clutched in to the turret and the turret would turn to the right.

Other methods employed the twist grip similar to that found in some motorcycles. But all these methods were quickly sorted out under stress of war and the power-operated gun turret is now incorporated in vast numbers of

British aircraft and has been responsible more than anything else for enabling Britain's biggest machines to beat off fighter attack.

RAF's Most Successful Bomber

Here then is one example of original unconventional thinking brought to a highly successful conclusion in war. It is matched, so far as the structural side is concerned, by the geodetic construction of the Vickers-Armstrong *Wellington*. This form of construction has frequently been described and it is not necessary here to repeat the details. In essentials it consists of a basketwork of criss-crossing metal members which themselves give the aircraft not only its strength but also its shape. In other words, the geodetic construction places the strength of the machine where it is needed near the surfaces of the aerodynamic shapes. In this it contrasts with more conventional construction wherein the strength is imparted through girders and struts which are inside the wings or fuselage and which do nothing to impart to them their aerodynamic shape.

The *Wellington* has a right claim to be one of the most successful heavy bombing aircraft of the whole war. It has worked in many theaters and under difficult conditions. It has been employed on most of the very long range attacks that the RAF has made and it has invariably given the fullest satisfaction. Constructionally it is probably the most outstanding case of all.

Why RAF Fighters Have The Advantage

In armament the success achieved by the RAF fighters must be attributed more to the unorthodox tactical thinking than to any special design novelties. It was decided some time before the war that British fighters would be given the power of hitting harder than any other fighters in the world. The consequence was that guns were packed into them to an extent never before thought possible. One other point is worth noting, that these guns were packed in such a way as to enable them to be used without any synchronizing or interrupter gear. In other words, they were so disposed as to be clear of the disk swept by the airscrew blades.

The Vickers-Armstrong *Spitfire* had eight guns mounted in its wings all fixed to fire forward in the line of flight and all outside the disk swept by the airscrew. Similarly, the Hawker *Hurricane* had eight guns mounted in its wings. The latter version of the *Hurricane* has no fewer than twelve machine guns, or, alternatively, four 20 mm. cannon.

This tremendously heavy armament for single seat fighters must be looked upon as unorthodox. It was not matched by anything in Germany or in any other country and it gave RAF fighter pilots a notable and lasting advantage over the enemy. The plan has been pushed even farther in the Bristol Beaufighter which carries four 20 mm. cannon and six machine-guns.

Courtesy "Flight"

Super fire power is packed in these "Hurricane II's" armed with either four 20 mm. cannons or twelve machine guns mounted in the wings and firing outside the propeller diameter.

When we turn to other classes of aircraft we find some notable unorthodox types, chief among them the Westland *Lysander* Army Co-operation machine. This aeroplane has had a long lease of useful life and has earned extremely high opinions from the pilots who have flown it. It has been used for innumerable different tasks, though most of them not of the kind that will see much publicity. It is still regarded as one of the best Army Co-operation aircraft in service today.

Its design is a brilliant piece of specialized work. For Army Co-operation purposes an aircraft must be able to take off from and land in a comparatively small area. Consequently the wing loading and the general wing arrangement of the *Lysander* is adapted to give a wide speed range. The aeroplane is capable of slow flying under full control yet it has a reasonably high top speed to enable it to meet all conditions under which it may be used. Partly this result is achieved by fitting the wings with Handley Page slots. These devices, by controlling the air flow over the wings, enable lift to be generated at lower speeds than would otherwise be possible.

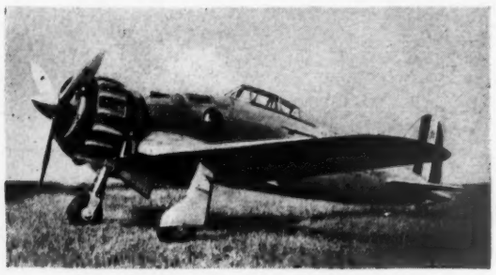
The *Lysander* is also a masterpiece of internal planning. It packs into its fuselage a vast quantity of equipment. High wing arrangement has the obvious purpose of allowing the pilot to get a clear view downwards. Lysanders have been used for an enormous variety of different tasks including message dropping and picking up and the dropping of containers for revictualling troops in isolated places.

Unorthodox Airacobras

These aircraft are instances of successful departures from orthodox design. They have played a vital part in RAF operations from the start of the war and they show that although the scope is restricted there still is scope for the novelty and for unconventional feature. More recently the RAF has taken into service the United States single seat fighter of extremely unorthodox design, the Bell *Airacobra*. This will be watched with especial interest for many people believe that it may point the way for useful future developments. Its engine installation behind the pilot, extension drive shaft to a hollow-hub propeller through which an automatic cannon is fired, and tricycle landing gear are all features now undergoing the rigorous trials of actual service conditions.

ITALIAN AIRCRAFT

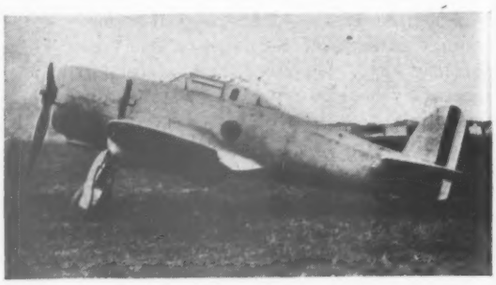
AT ONE TIME, in the late 20's and early 30's, the Italians possessed one of the largest air forces in the world, and even in 1935 it was a deciding factor in causing the British lion to refrain from straining the Ethiopian crisis to the breaking point. Today, however, the Regia Aeronautica is composed largely of outmoded designs of comparatively low performance. One of the fastest Italian pursuit planes, the Caproni Reggiane Re.2000 (see silhouette), has a high speed of only 329 mph. at 13,120 ft. See AVIATION'S *Foreign Aircraft Specifications* in the February, 1942 Yearbook for further details.



MACCHI C-200 FIGHTER

◀ All-metal fighter built by designers of successful Schneider Cup racers. Top speed is 313 m.p.h. Has seen service in Libya.

Single seat fighter with wooden wing and metal fuselage. Top speed of 304 m.p.h. is not impressive. ▶



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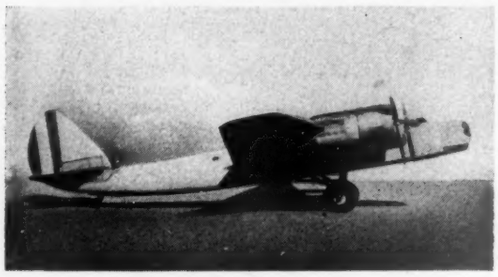
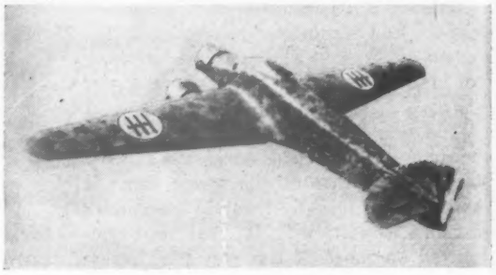


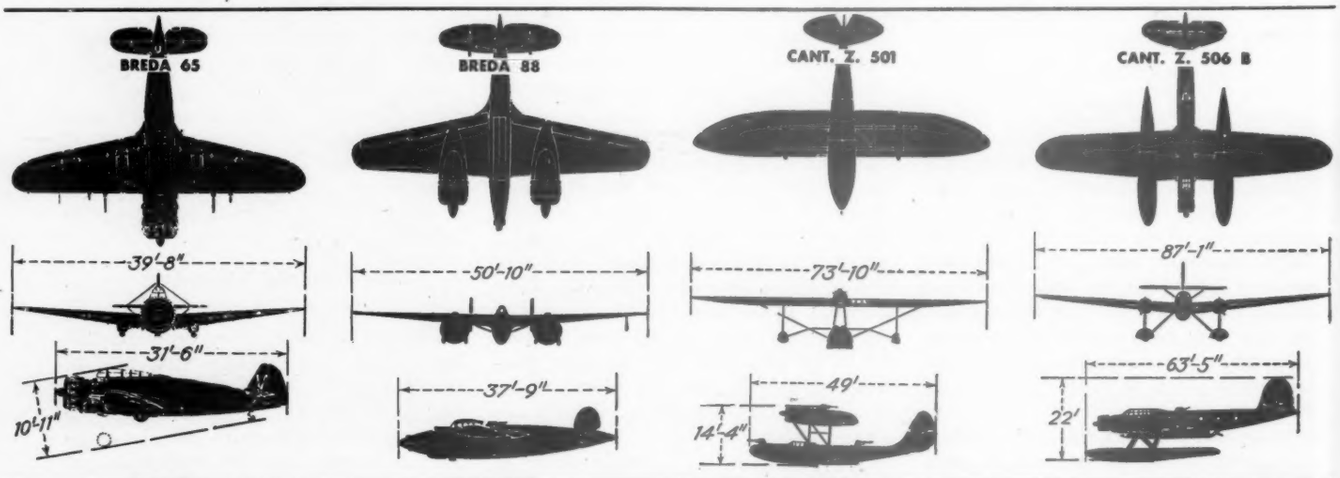
PIAGGIO P-50 HEAVY BOMBER

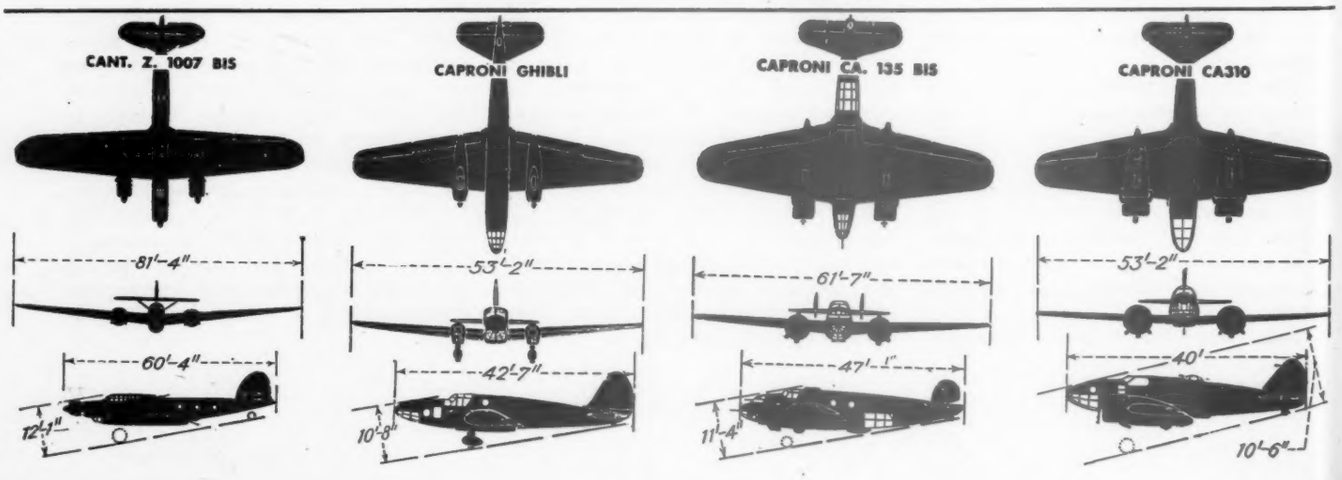
◀ Four-engine wooden bomber of fairly recent design. Has 1,240 mile range and cruises at 248 m.p.h.

Most widely used Italian bomber. Veteran of Spanish Revolution, now out of date. Wooden wing and metal fuselage. Top speed 294 m.p.h. ▶

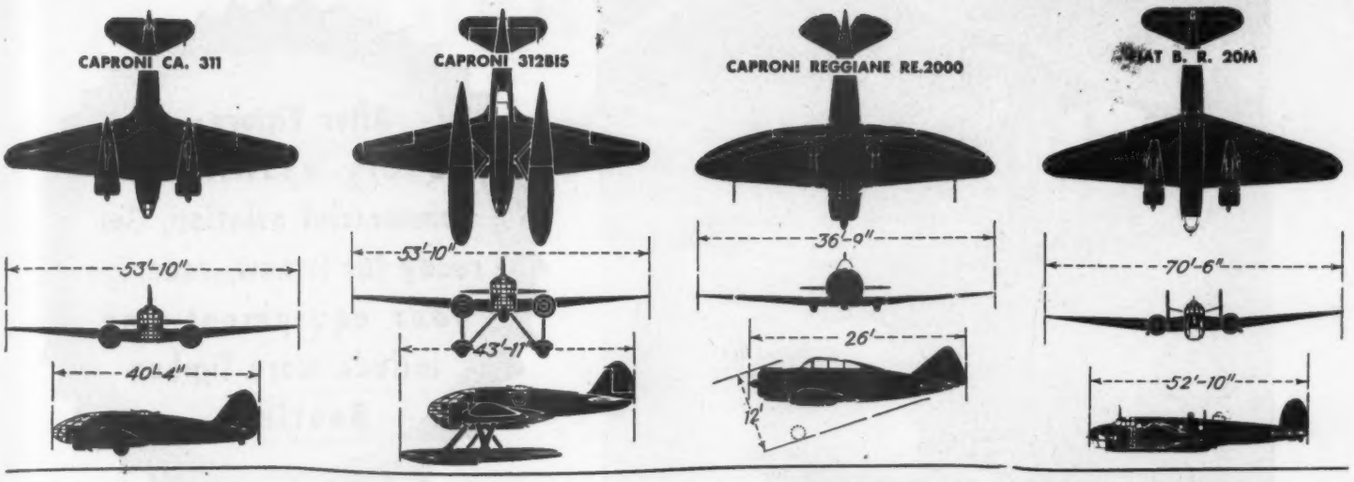


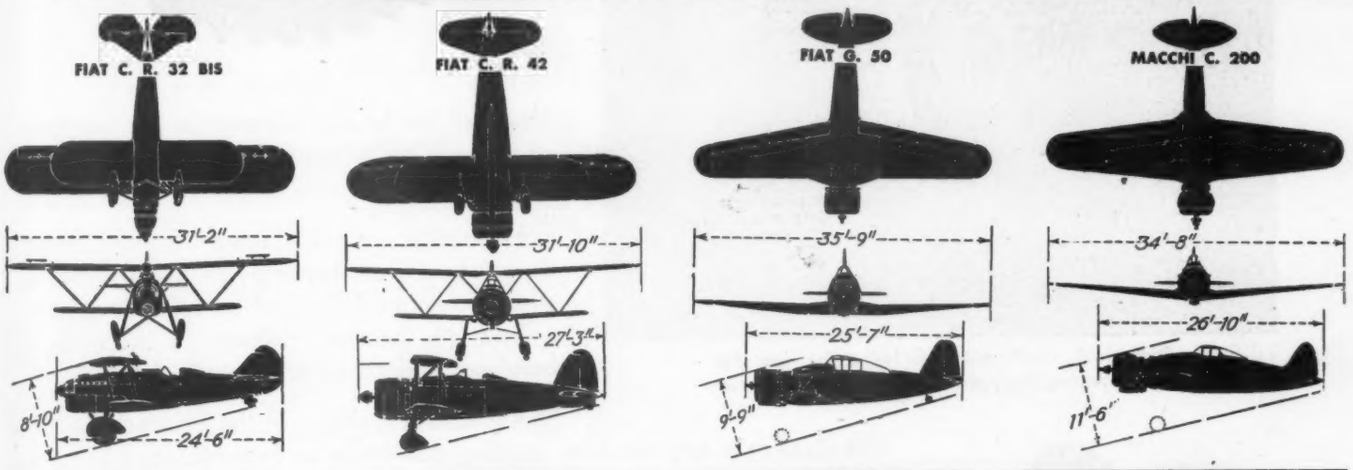
SAVOIA MARCHETTI S.M. 79

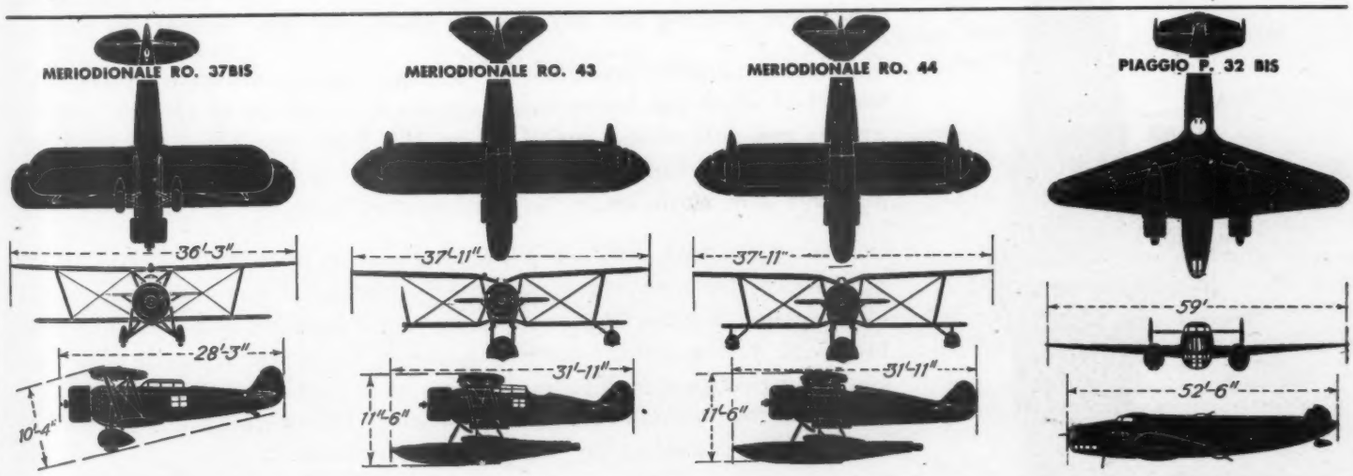


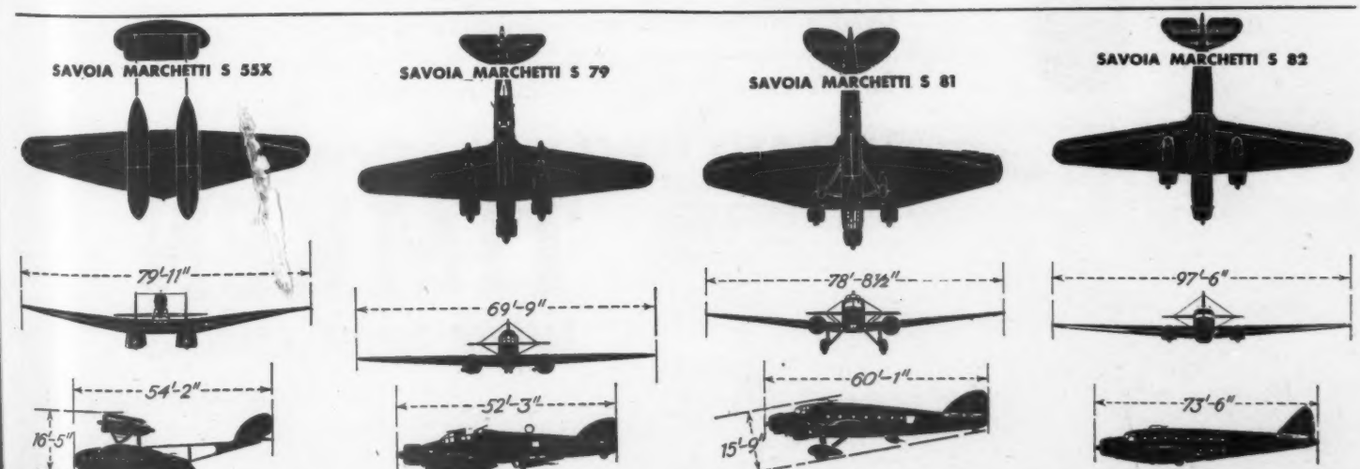


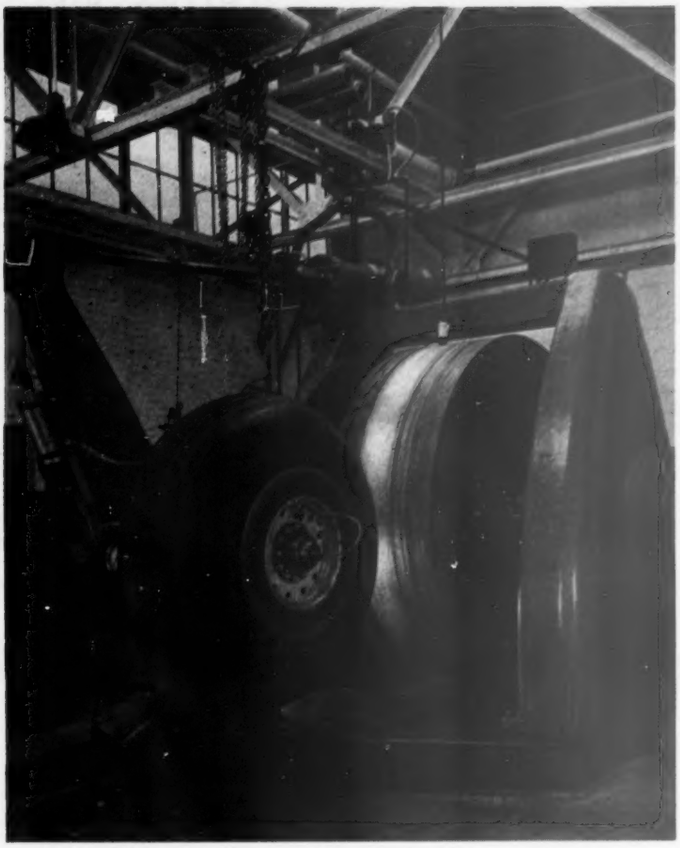
ITALIAN AIRCRAFT











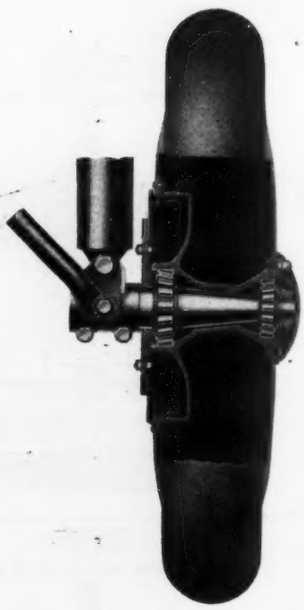
Photograph courtesy Hayes Industries, Inc. 56" Timken Bearing Equipped landing wheel shown in test.

After Victory—
a big upswing in commercial aviation. Get ready for it now; redesign your equipment and include more Timken Bearings.

Many of the lessons learned in the fiery air of war will be of tremendous value in post-victory aviation.

For example, a new machine has been developed for testing airplane landing wheels designed for use on military planes —from the smallest fighters to the largest bombers and troop transports.

This machine is shown in the photograph. It can duplicate any airplane landing condition as regards speed, load, shock and braking for any size of wheel and any weight of plane.



Typical application of Timken Bearings in airplane landing wheels.

The tester consists essentially of a large, heavy, drumlike wheel, the weight of which can be varied as required, turned by an electric motor at any pre-determined speed up to 100 miles per hour. The landing wheel to be tested is mounted midway on a hydraulically-operated movable arm as shown in the photograph.

In making the test, the heavy iron drum is set in motion, and as soon as it attains the pre-determined speed (representing the landing speed of the plane), the landing wheel under test is brought into forcible contact with it. The instant contact is made, the brake is applied in the landing wheel, which then must bring the drum to a full stop in 10 seconds. The procedure must be repeated 100 times before the landing wheel is accepted by the Army Air Forces.

Despite the terrific strain to which every part of the wheel—including the bearings—is subjected during this test, every Timken Bearing so far has come through in perfect condition.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

V ...— TO ASSURE VICTORY BUY UNITED STATES WAR SAVINGS BONDS & STAMPS

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IN THIS SECTION

Forming-By-Drawing . . Frohman Anderson 82

Mass Producing the A-20 Bombers John D. Weaver 86

Efficient Machine Loading . . . . Max Stupar 94

Improved Solutions of Remote Control Problems . . . . . Herbert Chase 97

Working Transparent Plastics, II John Sasso 105

Production Boosters at Fleetwings Perry Anderson 111

Forged Cylinder Head Developed by Wright 117

Perspective Drawings Speed Plane Assembly 118

American Mathematical Society Meets Dr. Arthur Korn 121

New Metal Stretching Press 121

Weight Engineers Meet in Chicago 122

Navy "E" to Grumman Aircraft 122

Welding Gas Conservation Imperative . . 125

AVIATION'S Sketch Book of Design Detail

Main bomb racks of the Short Stirling . 126

Bulkheads of the VS-44-A hull 126

Structure of gunner's enclosure on Messerschmitt Me 110 129

Cutaway of Bristol Hercules sleeve-valve radial engine 129

Fuselage interior of the Short Stirling bomber 131

Film on Tool Grinding and Cutting 132

Hydraulic Test Regulator 132

New Products and Equipment for the Aviation Industry

Modern Machine Tools 137

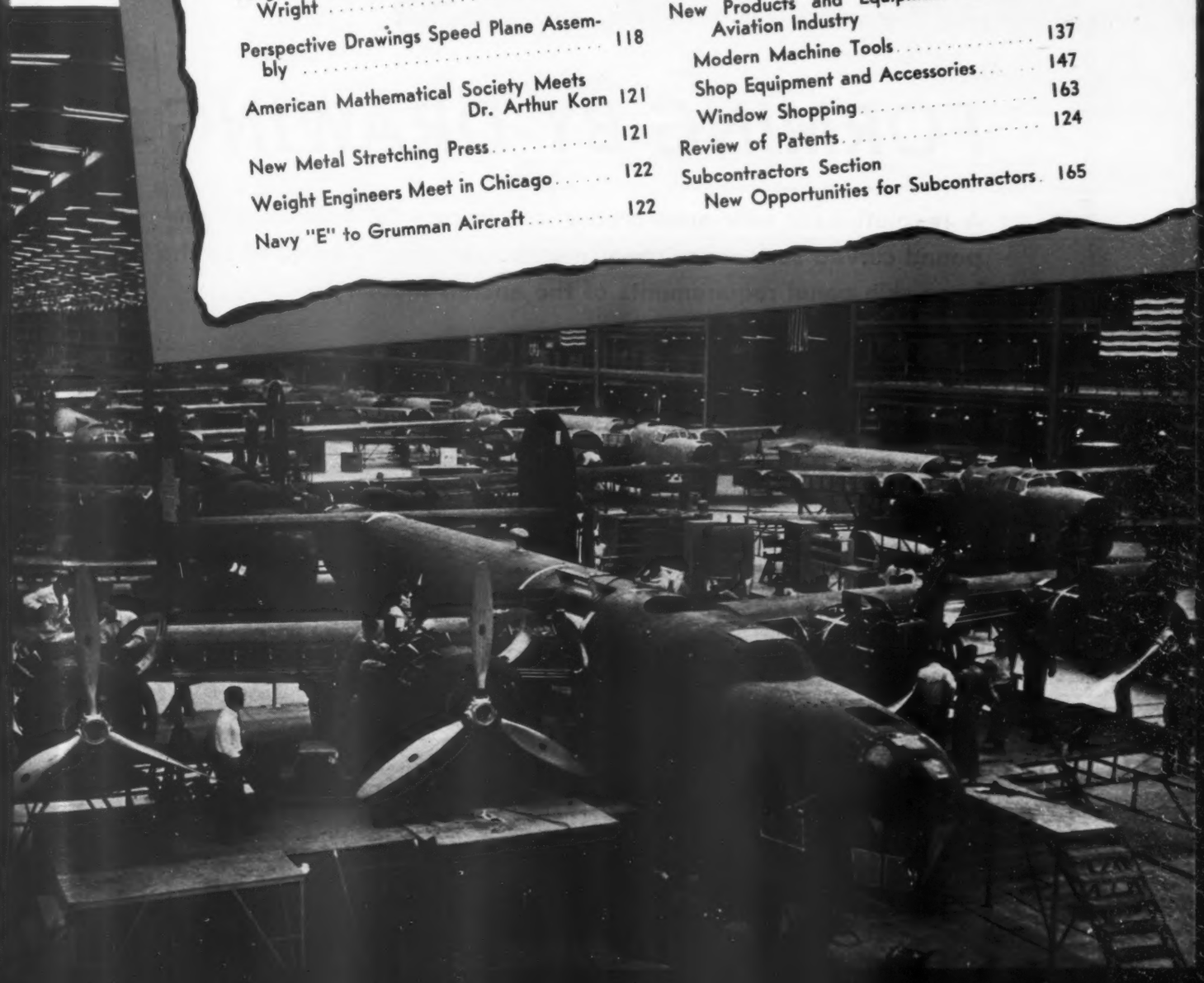
Shop Equipment and Accessories 147

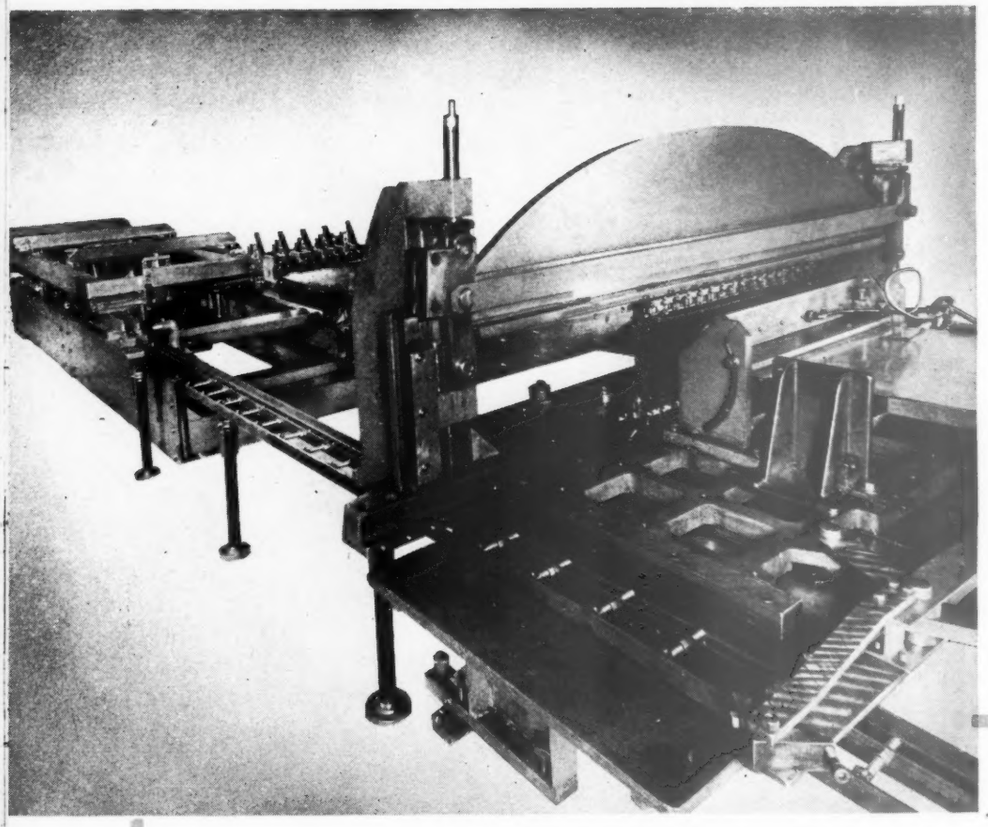
Window Shopping 163

Review of Patents 124

Subcontractors Section

New Opportunities for Subcontractors . 165





FORMING-BY-DRAWING

A revolutionary new mass-production process for producing compound curved surfaces in sheet metals, particularly adapted to the large skin panel requirements of the aircraft industry.

By FROHMAN ANDERSON, *President, Anderson Aircraft, Inc.*

THE "FORMING-BY-DRAWING" process is a new technique in metal forming. This process is distinguished from rolling, stamping or stretching methods in that the forming takes place by controlled drawing actions applied to a moving sheet while it travels at selected speeds.

Interchangeable forming and curve control elements are universally adjustable within very wide limits of curvatures. The number of different compound curved shapes that may be obtained by calibrated adjustments from a single set of these forming elements is infinite, as contrasted with the single shape obtained from the dies of the toggle, hydraulic, or stretch presses or the power hammer.

Using tabulated figures, and by interpolation, adjustment of the elements is made for a particular shape on simple adjusting fixtures while the machine may be engaged in other production work.

A change-over, to run a new shape, causes little loss of time since there are several sets of adjustable elements which are quickly interchangeable on the forming machine.

Aerodynamically speaking, the most efficient airframe skin panels have inherent characteristics that render them difficult or impossible to fabricate by conventional methods. The chief reasons are the limited size capacity of machines used and the spring back difficulties in die pressing or stretching shallow curves.

The Anderson Forming-by-Drawing

machines produce in a single stroke the shallow elongated compound curved airframe skin panels proportioned to cover large surface areas with a single sheet, with uniform mass production quality and speed. Besides the smoother, continuous surfaces obtained with large sheets, the elimination of a high percentage of joints results in labor saving and substantial conservation of strategic metals.

Scrap loss is kept at a minimum by this process. The sheet metal to be formed is held at one end and pulled through the forming devices. Generally only one to two inches of scrap metal result at the end of the sheet—none at the side. Several panels may be laid out in one large sheet and can all be formed in one stroke with even greater reduction in scrap and saving in time. Subsequent trimming operations may be accomplished as usual, or, in the case of straight trim lines and shallow compound curves, on a square shear, since there is no scrap to interfere. In some instances, panels may be trimmed to size before forming.

Various panels can be arranged so as to be formed in a single large sheet by nesting in tandem, single or multiple rows for the maximum reduction of scrap and maximum saving of time and labor.

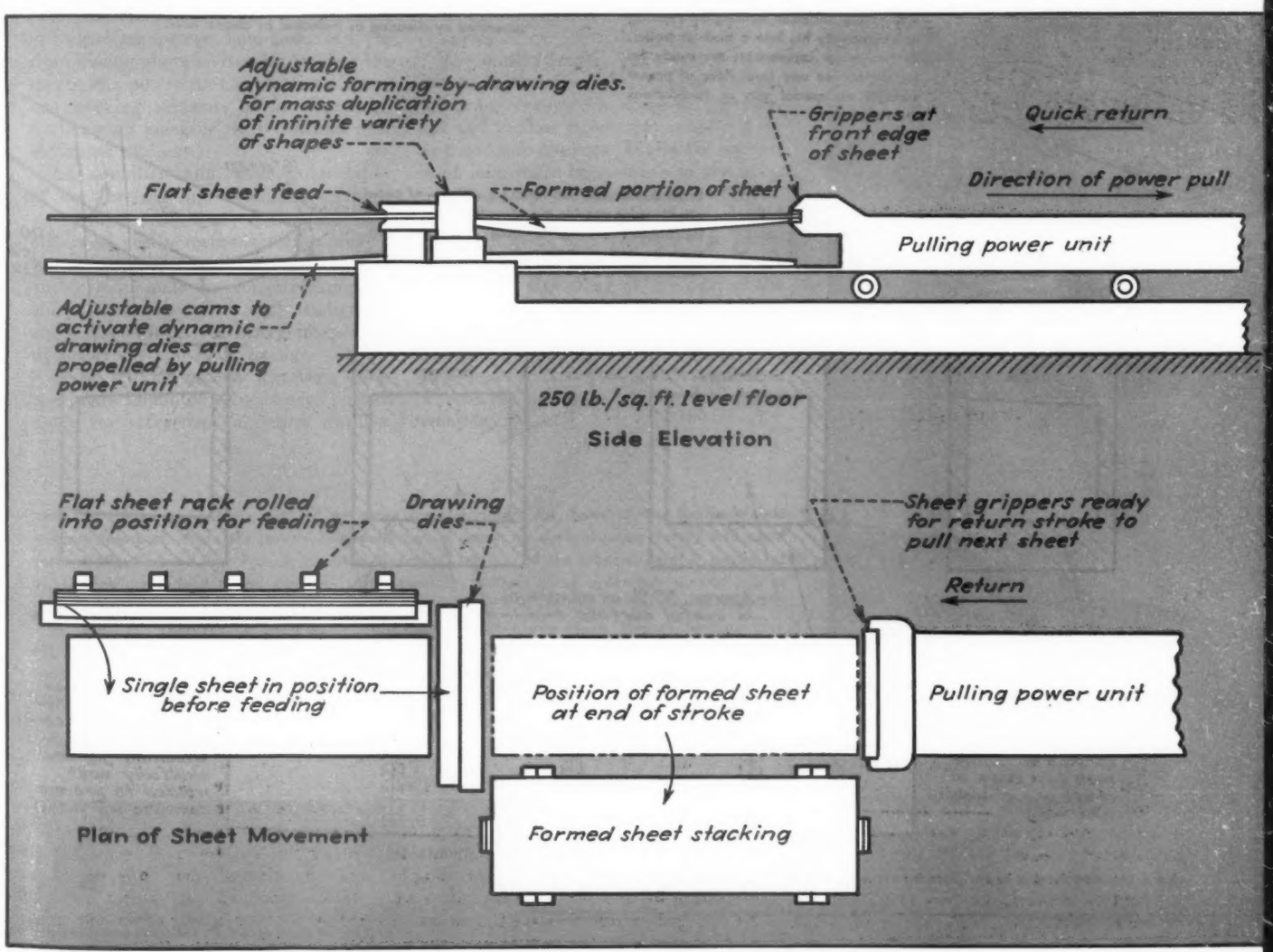
New shapes required by change in design are obtained simply by resetting the adjustable elements.

Some aircraft designers familiar with this process, realizing they need no longer be restricted to the use of small, narrow panels, have revised their designs for the use of larger panels with fewer joints, rivets and reinforcements, resulting in savings of weight, material and production time.

The machine is sufficiently flexible to cover almost the entire skin panel requirements of present-day airplanes. Eliminating, as it does, the use of patterns, molds, dies, jigs, power hammers, wheelers, drop hammers, huge stamping and hydraulic presses, and heat treating equipment, its potential contribution toward speeding aircraft output can readily be appreciated.

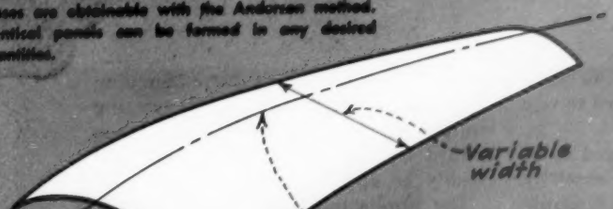
The application of the process also contributes ultimately to higher airspeed through better formation of individual panels and improved aerodynamic design. Simpler methods of construction and reductions in structural weight also result.

Since this is a drawing process, there is no tendency of the formed sheet to buckle and thus require additional treatment to maintain a smooth surface. In the drawing process the stretching of the metal is localized, in measured amounts, so that it is possible to add surface area only as needed to produce a certain curved surface. The strains in the metal are directly proportional to the amount of area added and are uniformly distributed, resulting in a minimum of change in its physical proper-

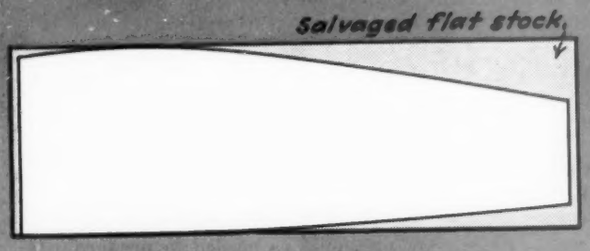

Adjustable dynamic forming-by-drawing dies. For mass duplication of infinite variety of shapes
Grippers at front edge of sheet
Quick return
Flat sheet feed
Formed portion of sheet
Direction of power pull
Pulling power unit
Adjustable cams to activate dynamic drawing dies are propelled by pulling power unit
250 lb./sq. ft. level floor
Side Elevation
Flat sheet rack rolled into position for feeding
Drawing dies
Sheet grippers ready for return stroke to pull next sheet
Return
Single sheet in position before feeding
Position of formed sheet at end of stroke
Pulling power unit
Formed sheet stacking
Plan of Sheet Movement

Simplified diagram shows basic elements and general principle of operation of Anderson process.

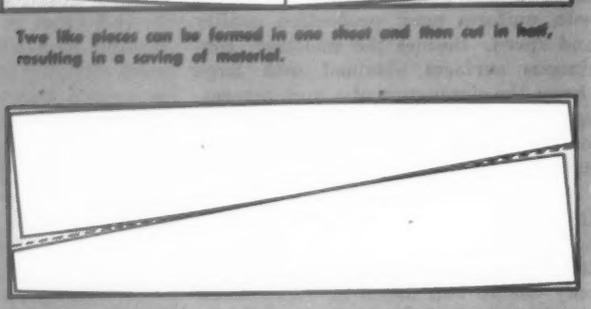
Variable compound curvatures with constant thicknesses are obtainable with the Anderson method. Identical panels can be formed in any desired quantities.



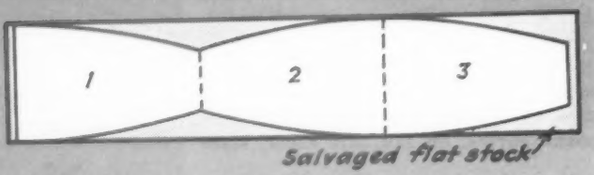
Two like pieces can be formed in one sheet and then cut in half, resulting in a saving of material.



Flat stock remaining after forming of odd-sized shapes is salvagable for ribs and other small stampings.

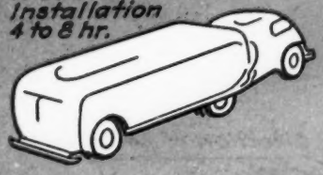


For pieces of irregular shape, raw stock can be sheared to approximate dimensions first, then formed and trimmed with little waste.



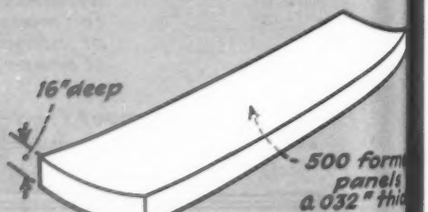
Several like pieces can be drawn to shape in a single strip and later separated by shearing as indicated by dotted lines.

Floor space 8'x50' to 8'x 70'
Installation 4 to 8 hr.

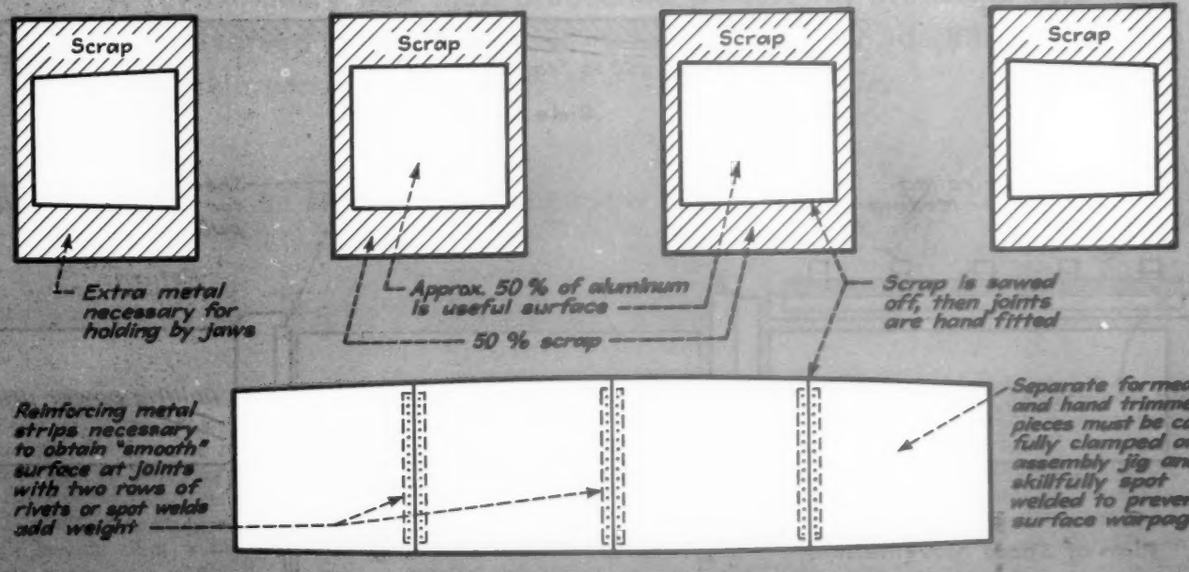


A complete Anderson forming-by-drawing unit compactly fits into a truck or trailer. Its two major components are ready for installation on any level floor of proper strength no special pits or foundations are necessary.

Exact duplication and resulting stiffness of panel after forming provide the unusual ideal conditions for compact stacking, handling, storing, packing, shipping and ultimately the trimming and assembling of the panel to the airframe.



Bomb bay door made in four stretched pieces requiring four forming dies.


Scrap
Scrap
Scrap
Scrap
Extra metal necessary for holding by jaws
Approx. 50 % of aluminum is useful surface
50 % scrap
Scrap is sawed off, then joints are hand fitted
Reinforcing metal strips necessary to obtain "smooth" surface at joints with two rows of rivets or spot welds add weight
Separate formed and hand trimmed pieces must be carefully clamped on assembly jig and skillfully spot welded to prevent surface warpage

Bomb bay door formed in one piece by the Anderson process.

1. Up to 30% of metal saved. 2. Tool costs practically eliminated. 3. [illegible] hours reduced in preparing blanks, forming, trimming, fitting, [illegible] bling, riveting & spot welding. Weight & materials reduced by elimi[illegible] rivets & reinforcing strips at joints. 3. Joint elimination results in [illegible] tiveness surface accompanied by considerable reduction of porosity [illegible] 4. Maximum weight-strength ratios obtained from complete assem[illegible] because of the larger panels and consequent reduction in number of j[illegible] curvatures are obtained with practically no reduction in thickness; [illegible] are subjected to a minimum of "cold-working" and strains are di[illegible] uted uniformly throughout the sheet.

ties. Change in gage thickness is considerably less and much more uniformly distributed than by other methods.

This process has been used with uniform success with high tensile stainless steel, monel, magnesium, brass and aluminum alloys of various degrees of hardness. The surface of the metal is not impaired by the action of the forming elements. This is true even with 24ST Alclad. The present machine has formed sheets ranging from .005 in. to .125 in. in thickness.

The machine itself consists of two major complementary units. The first is the forming-by-drawing machine through which the flat sheet passes and emerges in a curved shape. The second is the power unit which grips one end of the sheet and pulls it through the working elements of the Forming-by-Drawing machine.

Machine Is Flexible

These elements are timed and actuated in identical cycles, as desired, so that the exact duplication of formed sheets is obtained, surpassing the performance of wheelers, power hammers, etc., in reproducing shapes. Besides pulling the sheets, the power unit actuates the various working elements of the Forming-by-Drawing machine by timed and synchronized motions.

Adjustability and interchangeability of the forming and actuating elements do away with time consuming and otherwise costly methods using conventional stamping or drop hammer dies and forming male dies for stretching machines necessary for each individual shape, as well as the heavy inventories of such tools and their storage.

With the adjustable members, however, only tabulated records need be filed away for reference on future duplication of orders, and this is one of the most important features in the saving of time and tooling costs to the aircraft manufacturer.

In a continuous process, this method reproduces shapes with exact duplication and desired stiffness, providing ideal conditions for compact stacking, handling, storing, packing, shipping and ultimately the trimming and assembly of the panel to the airframe.

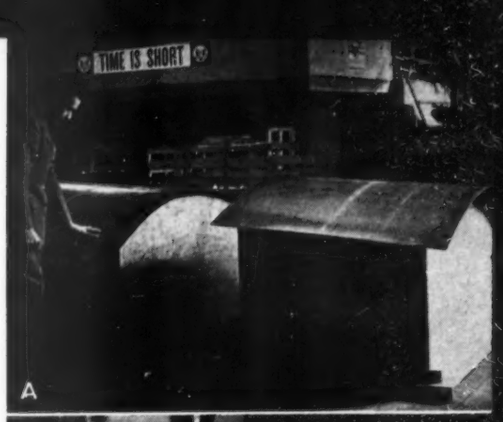
Reforming

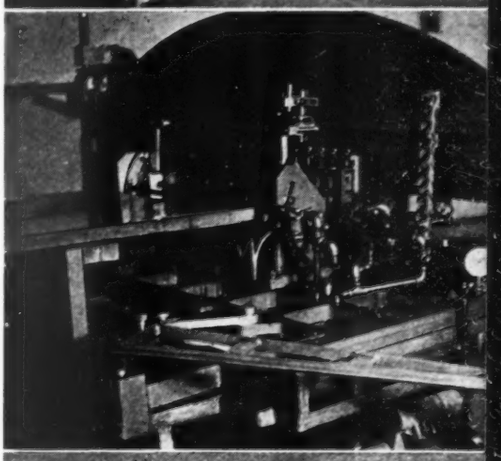
Besides forming flat sheets into compound curvatures, the machine can reform an already formed compound curved sheet into an entirely different shape. At times, when an engineering change has caused the alteration of formed panels in mid-production, the pre-formed sheets may be re-drawn into a new shape, without the necessity of scrapping.

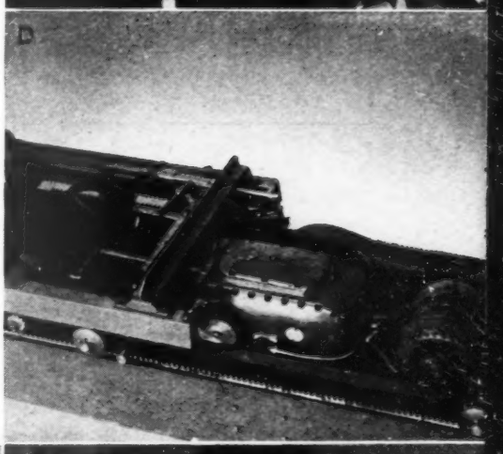
The present machine can accommodate metal sheets in any width up to 66 in., any length up to 24 ft. and thicknesses from .005 to .125 in. A 30-ft. stroke may be attained, however, with additional accessories.

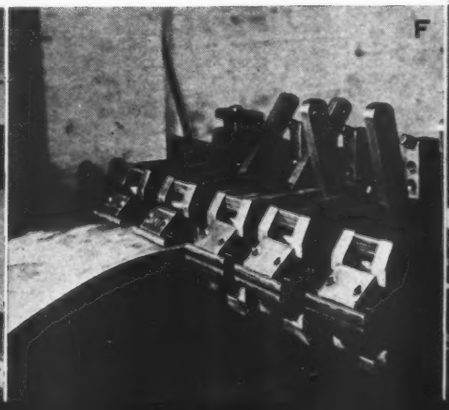
The width, length, gage and properties of material and the shapes are determining factors for speed of forming, but one to four panels per minute is an approximate average. While the process is of immediate importance to the aviation industry in the manner indicated, it is also applicable to the formation of frame members and other parts in which a modification of surface area through drawing or stretching of one part of the material more than the other is required.

The process is covered by pending patent application, and a multitude of new uses for it are being investigated as a research program of the developing company.









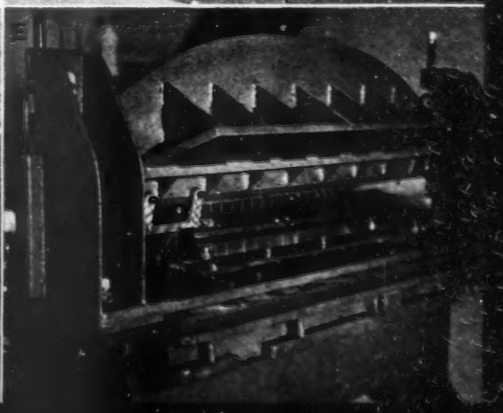
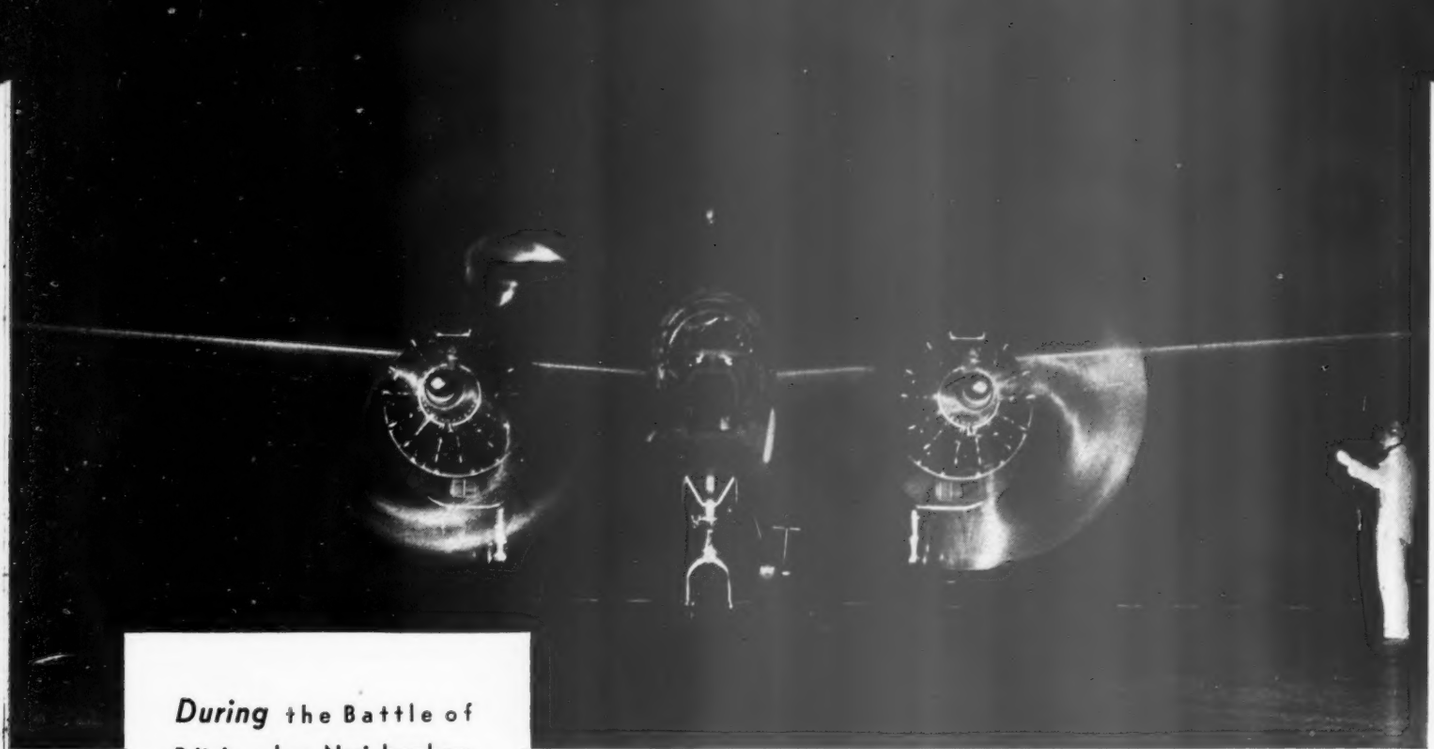


FIG. A. These sections are part of an order for skin panels for doors of the Curtiss-Wright military transport. Note the several compound curved panels on each checking fixture with exact form duplication and fit. FIG. B, Frohman Anderson, inventor of the process, holds a section of engine cowling formed by his machine. After drawing, sections check accurately against jigs or assemblies without further treatment. FIG. C. Feed side of the adjustable "forming-by-drawing" dies. FIG. D. Power unit of the pulling mechanism which draws sheets through forming dies. FIG. E. Expelling side of the dies through which sheets are drawn. FIG F. Gripper jaws on pulling unit clamp sheets of desired thickness and width. In operation these jaws clamp and release sheets automatically at either end of stroke. FIG. G. This is a skin panel for the bomb bay door of a Martin B-26 which was successfully formed in one piece. Note rigidity of sheet without support of any kind except at ends.



During the Battle of Britain, when Nazi bombers night-after-night rained death on London, the British turned to this plane to help repel the attackers. Originally supplied as the "Boston," a medium bomber, its speed, maneuverability and load-carrying capacity were such that the RAF mounted additional guns, called it the "Havoc," and sent it aloft where it proved a deadly efficient night fighter. In large numbers, it now serves the British in both versions.

MASS PRODUCING TH

The "How-it's-done" of Douglas Aircraft's magnificient achievement in rolling out the A-20's on its mechanized assembly lines in ever-increasing volume.

WITH "Speed and More Speed" the battle cry of anti-Axis production lines today, a goodly part of the answer is being literally "rung" on the Douglas Aircraft Company's A-20 production lines. There the ringing of bells moves A-20 attack bombers from the stock rooms to the flight-test ramps, as regularly as the clock ticks off the minutes. And at a rate of production far greater than was ever achieved before this new, mechanized method was perfected.

These A-20's are no low powered, light weight planes, either. They are, in fact, all-metal fighting craft whose British versions, known as *Boston* and *Havoc,* have already chased the Axis in Lybia, bombed the Axis-operated factories in the suburbs of Paris, and stalked Nazi raiders returning from the

FIG. 1. Hydraulic presses, the largest line of them currently in use in the aviation industry, form airplane parts under the pressure of rubber compressed to the hardness of steel by the Guerin process. FIG. 2. Electrically operated slides of hydraulic presses in Fig. 1, are shown here. The one in position to enter the press is fully loaded with dies and sheet metal and covered with "rubber blankets", equalizing the pressure of the thick rubber pad, which acts as a female die. On the slide at the left, the loading crew is arranging dies and sheet metal and covering them with the rubber blankets. It will then be ready to go under the press when one of the other three slides comes out.

THE A-20 BOMBERS

By JOHN D. WEAVER

Industrial Engineer, Douglas Aircraft Co.

black sky over London, as night fighters and bombers.

Designed for a crew of three, the U. S. Army Air Force's A-20 is classed as an attack bomber but is as fast as most single-seat pursuits, packing a remarkable load of bombs and ammunition, for distances no fighter can match. But, whether its specifications cause it to be labeled A-20 for the U. S., or *Boston* or *Havoc* for the British, it is a formidable combat plane, being produced in formidable numbers, on one of the most advanced, mechanized assembly lines in use anywhere.

Engineered under the direction of Arthur E. Raymond, vice-president in charge of engineering of all Douglas plants, the first version of the A-20 type was originally accepted by the U. S. Army Air Corps several years ago. Its original production method was "conventional" in that it was moved from jig-to-jig until finally it was capable of rolling on its own gear. But, as orders were piled upon orders, it became apparent that a faster and more efficient method, which permitted greater mechanization and more specialization by assembly line workers, could be evolved. The solution is our "vertical" assembly line.

The achievement was part of a complete streamlining of all Douglas plants. Into innumerable huddles went the team of President Donald W. Douglas, F. W. Conant, vice-president in charge of manufacturing, T. B. Coulter and T. H. Brennan, plant layout experts, and managers of the several Douglas plants, department supervisors, and representatives of production engineering, tool engineering, and numerous other departments. Out of those huddles came assembly lines that are original in design and so well suited to their purposes that adaptations are being widely used in other plants throughout the nation. The mechanized line for production of the A-20 was one of the first that has had ample time to prove its worth.

Before A-20 fuselages are fabricated, or are even needed for final assembly of the plane, thousands of man-hours of work have already gone into the making of thousands of separate parts, exclusive of the engines, that constitute the completed plane. These have been designed, methods of making them perfected, and their raw materials specified, each in its own way, at its proper time and place, and stored so it can be conveniently transported to that place where it will be fused into the whole.

Giant hydraulic presses, forming parts by the now well-known "Guerin" process, developed here at Douglas by Henry Guerin, manager of the Santa Monica plant, transform sheet stock into cut and formed parts. These, and thousands of others, whatever their size and shape, are transported through "streets" and "avenues" of the plants, by electric trains, run on regular schedules.

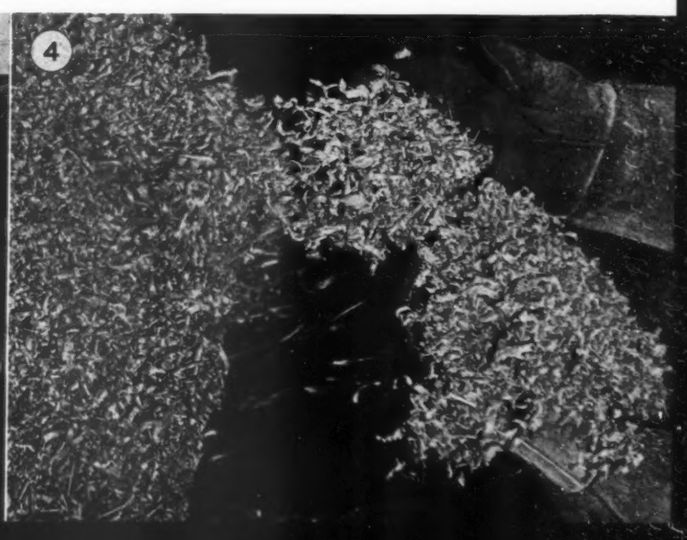
A Steady Stream of Salvage

Away from the presses, lathes, cutters, drilling machines and foundries goes a steady stream of "salvage" that is sorted, pressed into easy-to-handle bales, or boxed for shipment to processing plants where it is melted down again for re-use. And, all at a saving in materials and money that is impressive and important to the war effort and taxpayers' pocketbooks. In fact, hundreds of thousands of pounds worth millions of dollars are saved annually.

As do a number of other major airplane manufacturers, we prepare breakdown drawings of the subassemblies required for each type of plane. The A-20 breakdown accompanying this text will give an overall picture of the manufacturing problems involved. Divided roughly, the assembly might be said to come in six major steps, some proceeding simultaneously with others, and some following in sequence. Although it doesn't actually "happen" in this order, these six steps are: (1) Assembly of the fuselage, (2) assembling and joining inner wing sections, (3) attaching of landing gear, (4) mounting of the two Wright *Cyclone* engines, (5) addition of the tail assembly, and (6) attachment of the outer wing sections.

Throughout our plants, at each working "station" along the assembly lines, the production illustrations department of the engineering division has placed three-way, perspective drawings, similar to one accompanying this text, for the

FIG. 3. Material conservation at Douglas, a major division of the operating force, saves hundreds of thousands of pounds of scrap annually, valued in millions of dollars. These carts go through the plant picking up scrap cans. FIG. 4. These chips from machining and milling operations eventually return to aircraft plants again, in the form of careful segregation of various metals and alloys. This must begin at the machine where scrap originates, because separation of mixed aluminum alloys is difficult, sometimes impossible. Stainless steel, for example, if permitted to find its way into aluminum scrap renders it useless for salvage.



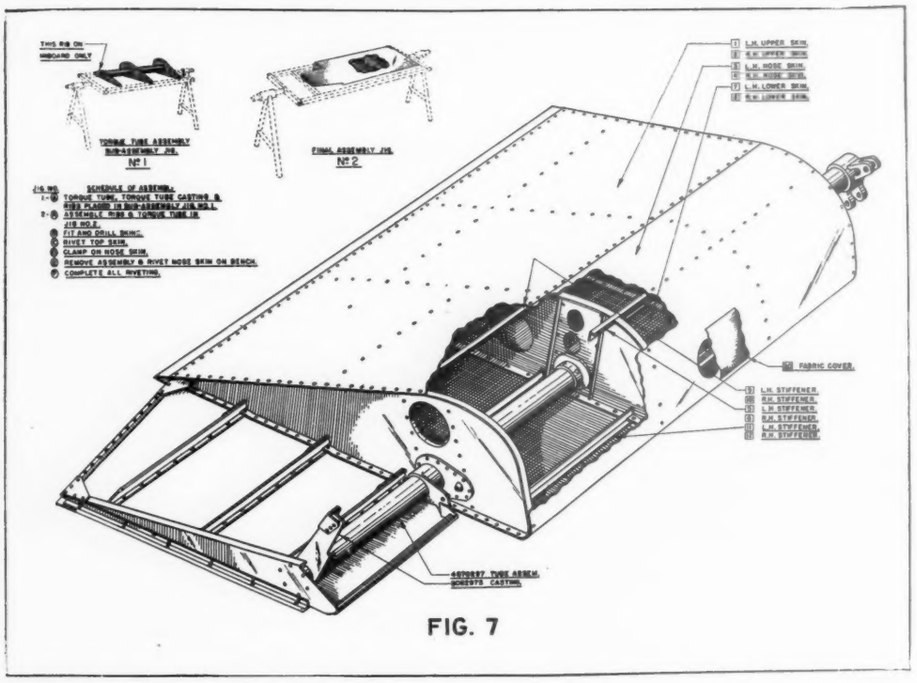


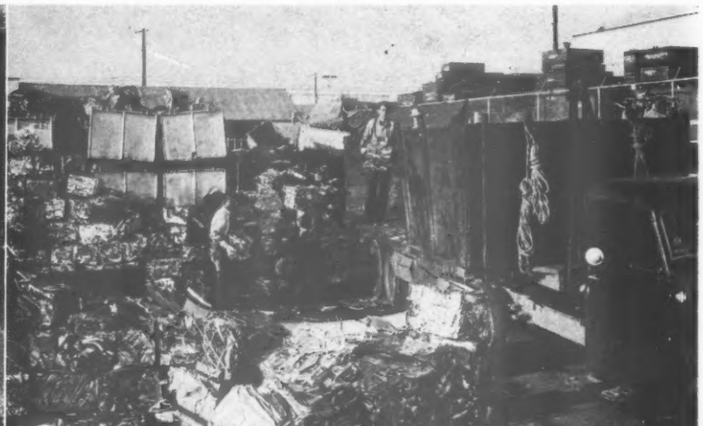
FIG. 7

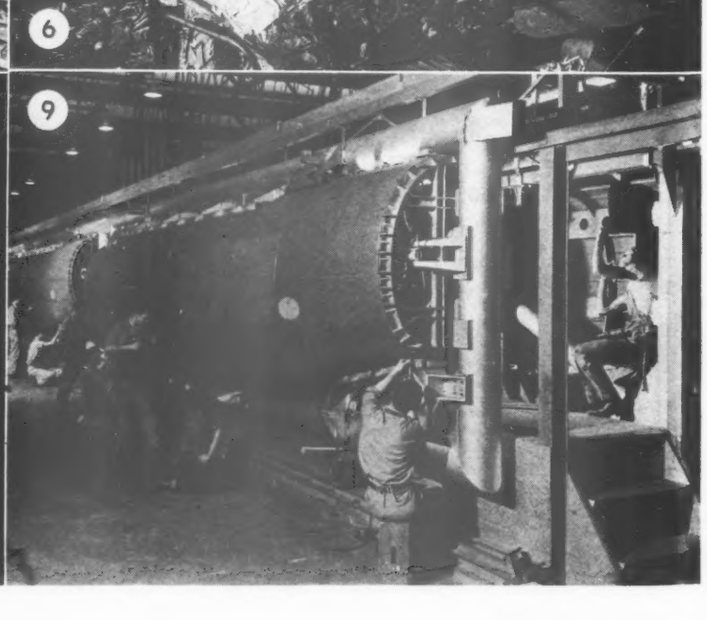
FIG. 7. At each working position or station, unit breakdown, three-way perspective drawings are before workmen at all times, to familiarize them with their respective jobs.

guidance of our craftsmen. By having before them, at all times, a clear, easy-to-understand guide, each man or team knows what is to be done and the best way to do it. In fact, the only way to do it.

Another example of this "visualizing" of the job, is our method of constructing assemblies, as far as is possible, in

FIG. 5. The scrap metal being thrown into the hopper for baling here is of every size and shape, but the pieces are all of the same aluminum alloy, for one foreign element might make salvage impossible. FIG. 6. After the scrap has been segregated, collected and pressed into compact bales, it is carted away by the truckload to be shipped back to the smelters and mills. FIG. 8. An A-20 nose assembly. From foundation beam to its last window, this nose was carried along, sidewise, in the same position and at the same height shown, convenient for all who worked on it. FIG. 9. An end view of the A-20 fuselage half-shell assembly lines. When these workmen have finished, the half-shells will be lifted from these jigs, by overhead cranes and will proceed, sidewise, for the balance of the way down the line, in dollies run in floor tracks.





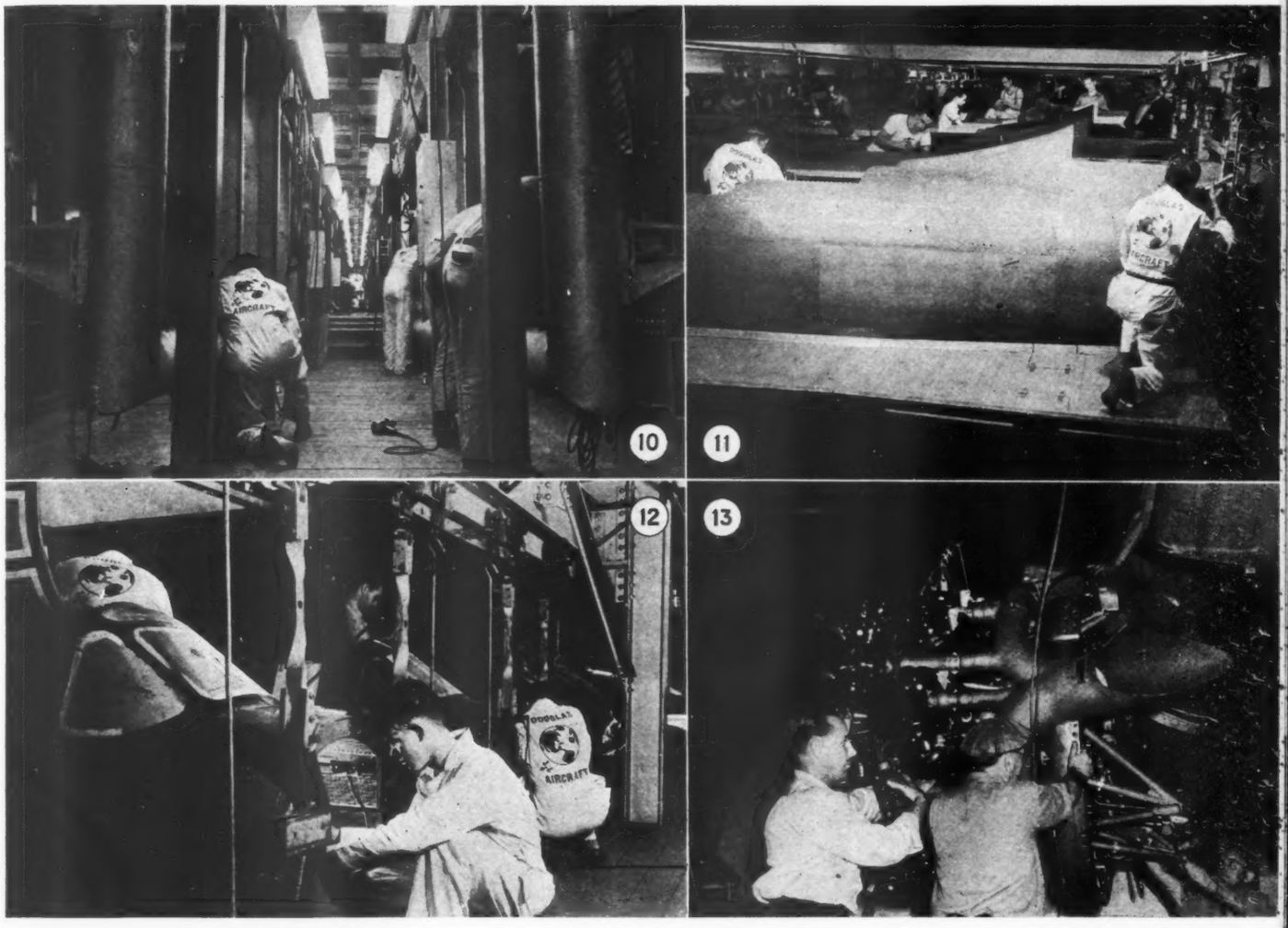


FIG. 10. Between the right and left half mobile fuselage lines is this well-lighted aisle in which workmen work on the interiors of the half-shells. Drills, rivet guns and other necessary tools are suspended from above, convenient to their point of use. FIG. 11. After A-20 half-shells are joined into a single unit and are attached to overhead conveyor, they proceed, sidewise, down this line where final operations are performed. FIG. 12. After A-20 fuselage half-shells have been joined, they proceed down this line, carried on overhead tracks, as workmen make installations and inspections from platforms and catwalks between them and at their ends. FIG. 13. Before the A-20 fuselage, now with its inner wings, landing gear and tail assembly in place, enters the spray booth, an overhead crane swings its two Wright Cyclone engines into place.

the same position they will have on the completed ship. Take the nose of the A-20 as an example. It is fabricated also on a vertical line where it grows, step-by-step, from its foundation piece to its final inspection, while being carried along, sidewise, at convenient working height, in the same position it will have on the plane. Because our craftsmen can see it as it will appear on the plane, he finds it easier to grasp what he is doing, why it has to be done that way, and takes pride in doing his job well. Error and delay are minimized.

And, just as the nose, fuselage and other major assemblies are constructed on mechanized lines, so, too, are the inner wing section, shown in another accompanying illustration. Down the tracks of this line go jigs, each with its load rapidly taking shape, to come off at the far end, a completed inner wing section.

We at Douglas take considerable pride in the development and innovations of the Guerin process; the flush-riveting process developed here and turned over to the industry; in extensive material conservation; and are moving strenuously to exceed all expectations, high as they are, for our portions of the airplane production program. But, we are proudest of the mechanized production line technique developed here, and elsewhere in the aircraft industry.

To build A-20 fuselages we adopted the longitudinal or "half-shell" plan, whereby right and left halves are fabricated separately and, when complete with all required installations, are joined into a completed fuselage. This method offered means to construct each half, fit it speedily and handily with all interior installations, with craftsmen working on both sides of each half-shell simultaneously, and with practically no crawling into small cramped places.

The line itself is carried on two steel rails, one near the floor and one about nine feet directly above the lower rail, mounted on a sturdy framework of wood and steel that also carries electrical and compressed air outlets, light fixtures, tool racks, and such other lines as each station requires. Hanging from the top rail and running on the bottom one, are giant rectangular frames of welded, ten-inch steel tubing. Within these frames or jigs are the attachment brackets and locking pins by means of which longerons and stringers and other parts of the fuselage structure are held in place until they are locked firmly together by rivets.

Starting empty, but directly from a

AIR SPEED INDICATOR
TELEGON REMOTE INDICATOR
(Quadruple Engine Unit)
SENSITIVE ALTIMETER
DIRECTION INDICATOR
(Compass)
MANIFOLD PRESSURE GAGE
ELECTRICALLY HEATED PITOT-STATIC TUBE
CRADLE OF PRECISION
Many of the world's most important contributions to precision aircraft instruments have been cradled on the Kollsman drafting board. The first practical Sensitive Altimeter and the Direction Indicator are notable examples. Kollsman craftsmen have, in fact, either created or refined almost every type of precision aircraft instrument.
Those shown here are but a few of the more familiar types—their faces open to view and easy to read, which is typical of Kollsman design.
These instruments and many others—many of them only ideas stirring in the minds of Kollsman engineers in our great research laboratories—are Kollsman's contribution to aircraft of the United Nations at war today . . .
And to the commercial and private planes that will circle the earth in a world at peace tomorrow.
VERTICAL SPEED INDICATOR
TACHOMETERS
(Direct and Remote Indicating)
ENGINE GAGE UNIT
FREE AIR THERMOMETER
(Ice Warning Indicator)
KOLLSMAN
AIRCRAFT INSTRUMENTS
Division of
SQUARE D COMPANY
ELMHURST, NEW YORK • GLENDALE, CALIFORNIA
DETROIT, MICHIGAN

master jig where it has been thoroughly checked for perfect alignment, the jig picks up longerons and stringers in the first working position, gets more of them in the next, and continues to succeeding stations where the skin is clamped on and later riveted.

Because of the half-shell method, workmen can be and are stationed, at irregular intervals, down both sides of each half-shell line. They work in teams or individually without interfering with each other. Tools, such as drills or rivet guns, are permanently suspended or racked convenient to their point of use, eliminating the time formerly lost in checking them in and out of tool cribs as shifts changed, and freeing aisles of traffic jams of workmen waiting to return or obtain tools.

Directly above each position are clusters of fluorescent lighting fixtures that flood it with ample, non-glaring light.

In bins or on racks, generally behind the workman, but in some instances at his side, at the edge of the aisle but never in it, are the exact number of parts and rivets, screws, bolts, or clamps required to attach them. These were delivered, conveniently ahead of their scheduled use, by the electric train that supplies that particular station.

When the allotted time for each position's operations has elapsed, a bell rings and the entire line of jigs moves forward one position, under power furnished by an electric winch. Each move makes room for another jig to start down the assembly line. Each has come back to the starting point by way of a return track that extends from the completion end to the master jig, at the starting end.

Paralleling this fuselage "left half" line is another on which "right halves" are being simultaneously assembled. The work progresses in perfect unison, both halves reaching the "end of the line", or approximately the half-way point, at the same time. There, with longerons and stringers and skin compeltely riveted, and initial installations also in place, both halves are removed from their respective jigs for the first time.

Overhead cranes pick up the half-shells, give them a quarter turn, and deposit them in separate dollies that are a convenient working distance apart, but hold the half-shells with their inner surfaces facing each other, ready to be joined. On these dollies the half-shells continue on down the line, but now moving sidewise instead of endwise as they started. Interior installations are completed in this position, at several stations and the two halves are then simply and speedily joined.

Relieved of their half-shell loads, the original jigs are picked up by overhead cranes and swung over to the return track where they are towed back to the master jig for a complete check of their accuracy, stopping enroute if necessary, for any repairs or adjustments that may be needed.

The completed and joined fuselage next acquires its two inner-wing sections. These were assembled on another, horizontal line of unusual design. On this "wing track" inner-wing sections start as three subassemblies that are joined in a stationary jig. When the necessary mountings are attached, this beginning assembly is removed from the jig and enters the wing track assembly line.

This track, developed here at Douglas and now adapted elsewhere in the industry, holds the inner wing sections, rights and lefts alternating down its entire length, at a convenient working height. At each station additional parts are joined until, when each assembly reaches the far end, it is ready to be swung by overhead crane, into position for mounting on the fuselage.

As the fuselage and inner wing sections are joined, landing gear is attached, and then engines and tail assembly are set in place. The rapidly shaping ship is now rolling down another assembly line over which a huge spray booth has been erected. As it passes through this booth it acquires its camouflaged finish. Then continues to roll, on tracks, to the final assembly.

At the beginning of the final assembly, outer wings are attached and the virtually completed plane is switched to one of two final assembly tracks where it rolls by gravity, on its own steerable front wheel and dollies, in a diagonal position, to the far end where it leaves the line a completed A-20 type bomber, ready for its check flight.

This final assembly line is believed to be the only one that harnesses the force of gravity, saving both manpower and mechanical power. A gently sloping floor provides free motive power for the movement of each plane from station-to-station during final assembly. Simple but effective brakes stop and hold each plane at each station, as bomb racks, cockpit hatches, and other assemblies are added.

Here, too, numerous tests are made, among them that of the hydraulic controls, retraction mechanism of the landing gear, and final checks by the U. S. Army Air Forces' inspectors.

On such production lines then, the A-20's and their *Boston* and *Havoc* relatives are born and given the unsurpassed stamina, speed and maneuverability that prompted Lieut.-Gen. Henry H. Arnold, chief of the United States Army Air Forces, to wire Douglas employees recently, as follows:

"Douglas bombers have smashed at the enemy again. Four *Bostons*, piloted by Allied airmen, made a pioneer daylight raid over the Libyan desert on the Nazi airbase at Martuba in North Africa. Diving on their targets, they sent hangars up in flames. Teaming up with American made fighter planes, they then bagged four German pursuit ships."

Perhaps before this can be published A-20 kin of those *Bostons* will be demonstrating to the Axis that being born "on the half-shell" is no handicap.

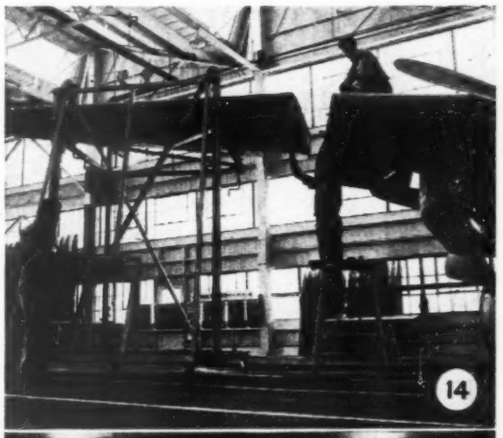


FIG. 14. Outer wing, carried on a specially designed hoist, is lifted to the correct height and rolled into place for joining to the inner wing. After this operation, the ship will roll, on its own nose wheel and dollies, by gravity down the final assembly line. FIG. 15. Virtually completed A-20's moving down final assembly lines. Note that at this point the airplanes still are run along tracks, dollies at two points under the fuselage fit into these tracks while the third point of support is the steerable nose wheel. This final assembly line is notable in that it is a gravity feed line, the airplanes rolling down of their own weight along the track which is inclined a few degrees, and the planes being stopped quickly and easily where desired by a simple brake, thereby saving both mechanical and manpower.

ONE EVERY EIGHT MINUTES!

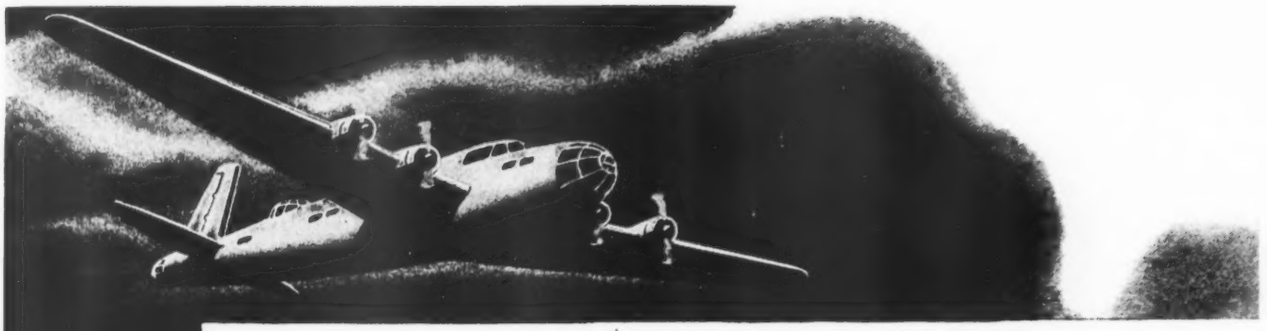
THROUGH the fog-streaked dawn of the North Atlantic . . . over the palm-fringed isles of the Pacific . . . American aircraft are carrying the war to the enemy thousands of miles from our shores. And these are but the vanguard of the 60,000 warplanes this nation is pledged to put in the air this year.

America must make good this promise, at whatever cost in toil and sweat and sacrifice. It means the aircraft industry must produce a complete airplane every eight minutes, every hour, day and night, seven days a week. Into each plane must go thousands of precision-built parts from hundreds of factories — *the greatest construction job any nation ever attempted in so short a time!*

To Goodyear Aircraft has been assigned the duty of building subassemblies—airplane wing, tail and fuselage units, flight control cabins, floats and other parts for several types of fighters, as well as medium and heavy bombers. This number-one war effort is engaging all the engineering skill, facilities and resources Goodyear has amassed in its thirty years of aeronautical experience.

And beyond this, the men and women at Goodyear Aircraft have promised the nation, through their Joint Labor-Management Committee, to do their utmost in helping the aircraft industry maintain the *plane-every-eight-minutes* schedule. For all of us here realize that we, too, are soldiers in the Battle of America; that our American freedom, our standard of living, all our hopes for the future depend upon this nation winning command of the air

GOODYEAR AIRCRAFT



STOPPING 80 TONS AT 200 MPH —IN 29.4 SECONDS

HERE you see one of a battery of airplane tire, brake and wheel testing machines with which Goodyear creates in the laboratory landing loads far more severe than occur in any but emergency landings.

The range of this "laboratory landing" apparatus is practically unlimited. It will apply landing loads on tires and wheels ranging from those of the lightest C. P. T. trainer to the giant landing wheels of an 80-ton bomber. It will exert 56,000,000 ft-lbs of energy against a brake designed to stop an 80-ton bomber landing at 200 mph in 29.4 seconds.

This is but one of the many steps Goodyear takes to insure the uniform high quality and serviceability of all its tires, tubes, wheels and brakes. Hydraulic burst tests, load-deflection tests, bruise, fatigue and balance tests are all part of the production routine that gives Goodyear airplane tires utmost dependability under the most critical wartime conditions.

Goodyear Hydraulic Disc Brakes are put through their paces, both at extemely high temperatures, and down to 40° below zero. Wheels are subjected to radial and side-load pressures in excess of the rigid requirements of the air forces. In all these ways we make certain that Goodyear wheel equipment will meet the acid test of the battlefield, both on today's warplanes and the bigger, faster craft to come.

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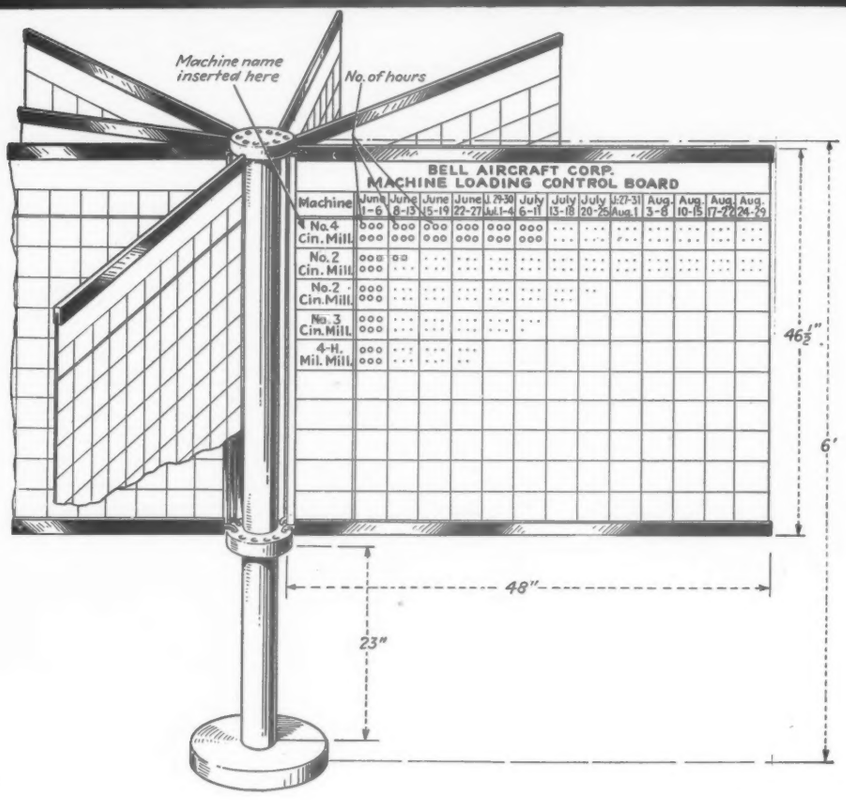


MACHINE LOADING CONTROL BOARD AT BELL AIRCRAFT—The complete setup consists of a number of boards, painted black, ruled vertically, drilled for pins and mounted on a post column, so that each board swings like a page of a book.

Each board carries only one kind of machine; all milling machines are on one board, all turret lathes are on one board, all automatic screw machines, etc.

This system permits individual machines to be scheduled, or a group of machines, consisting of any number, may be bracketed by a rubber band indicator and scheduled the same as an individual machine.

Efficient Machine Loading

"Just simple arithmetic," Bell Aircraft engineers call it, but their "simple" methods produce more airplanes in less time.

By MAX STUPAR
Coordinator of Production, Bell Aircraft Corp.

When all types of machinery and tools are at a premium, failure to achieve maximum utilization from each is little short of criminal—every idle machine is working for Hitler, Hirohito & Co. Bell Aircraft's production engineers have worked out a system which materially assists in reducing lost and idle time of machines to the irreducible minimum.

TO ASSIST in maintaining a smooth flow of production and to achieve the maximum efficiency in the utilization of its machine tools and fixtures, Bell Aircraft engineers have developed a coordinated system of time studies and machine loading which gives surprising results.

The system evolved has played an important part in the remarkable reductions accomplished in man-hours of labor necessary to produce each airplane. Now, man-hours per plane are but 44 percent of the original requirement, and still being reduced!

In the first place, 95 percent of the work is designed and tooled to go on standard machines. When a new piece is released from the design engineers to the production planning engineers, the estimating department is called in to work out a standard time estimate for each piece, based on past experience with similar work.

Knowing the number of pieces required, when they must be finished, and the estimated total man-hours for each operation, reference is made to the machine loading board. This shows for months ahead the actual load in man-hours, and number of shifts scheduled for each machine.

If with the maximum possible utilization of machines available it would be impossible to meet the established schedules the essential information is at hand upon which to base a decision as to how machine work must be contracted outside or how much new machinery must be acquired.

Easiest Work Subcontracted

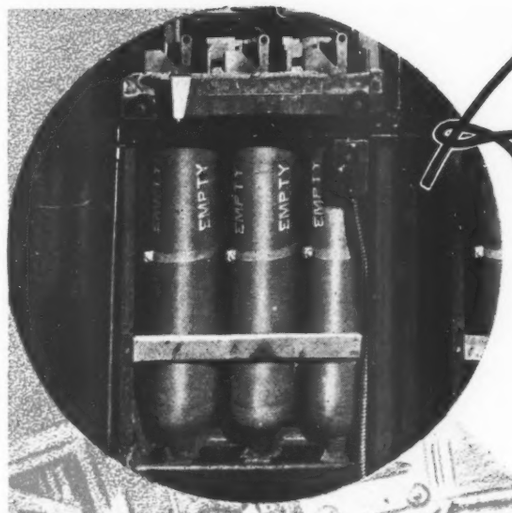
Generally, only the easiest jobs are sent outside, knowing full well that we are better able to cope with the toughest jobs in our own shop and avoid delays incident to extensive training of new people. It is, of course, possible for us to maintain more complete control of work in our own shops.

It is especially important to keep in our own shop all jobs using critical raw materials. Since deliveries of specific quantities are under strict control, we cannot risk abnormal wastage through mistakes or faulty workmanship.

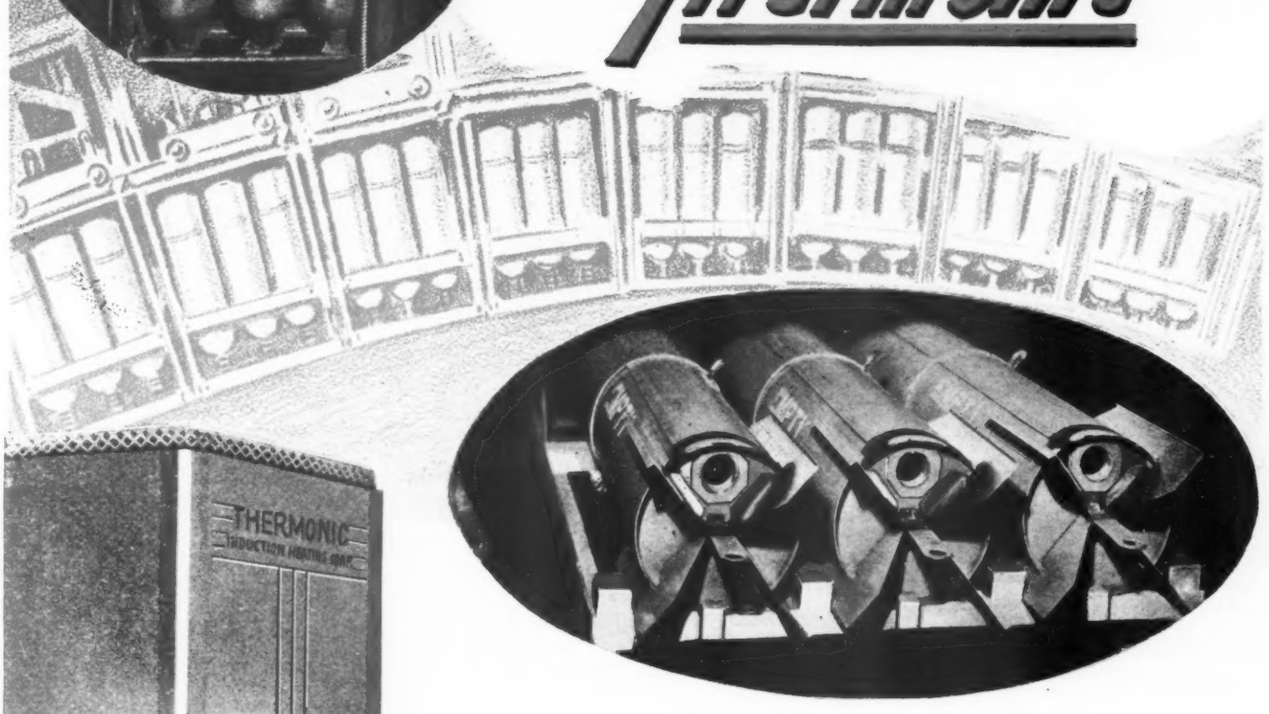
In this connection, it is interesting to note that a relatively inefficient method of production from the standpoint of time consumed is sometimes selected in preference to the most efficient if it happens that the one method more completely utilizes such critical raw materials.

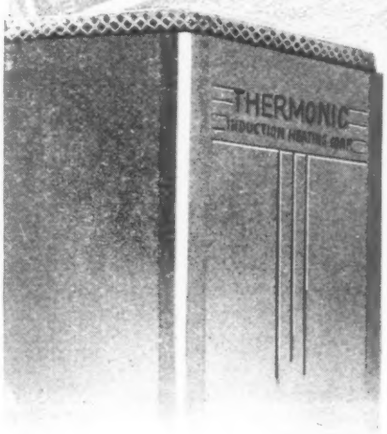
As soon as a piece starts through the shop, the time study engineers go to work on the actual time study data as contrasted with the estimates. Plus and minus factors are established for all possible circumstances and contingencies so that schedules can be worked out with extreme accuracy.

(*Turn to page* 256)



Another Difficult Problem Solved by Thermonic





The problem of brazing a ¾" threaded flange into a completely closed 20 gauge sheet steel container was solved by Induction Heating.

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With this process it was possible to perform three brazes simultaneously, in 35 seconds.

A pre-placed ring of Easy-Flo Silver Alloy melted and flowed to form a perfect, air-tight joint.

This is only one of the many problems solved by Thermonic in this "War for Survival". The same engineering staff that solved this problem are available to you.

A series of Data Sheets completely covering the subject of Induction Heating will be issued monthly. No. 1 is ready for you. Write to Department B.

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Openings in the open end are angled at 15° for efficiency, while the box end is offset at 15° to provide clearance.

Available as single wrenches or in complete sets to meet individual needs. Your local jobber will be glad to give you complete information—or write for catalog listing the full range of sizes and showing the complete line of Bonney Tools for Production—Maintenance—and Service.

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Improved Solutions Of Remote Control Problems

As size and performance of aircraft increases, problems attendant upon weight and complexity of controls and control couplings multiply rapidly. Light and compact electrically operated control units provide the answer in many instances.

By HERBERT CHASE

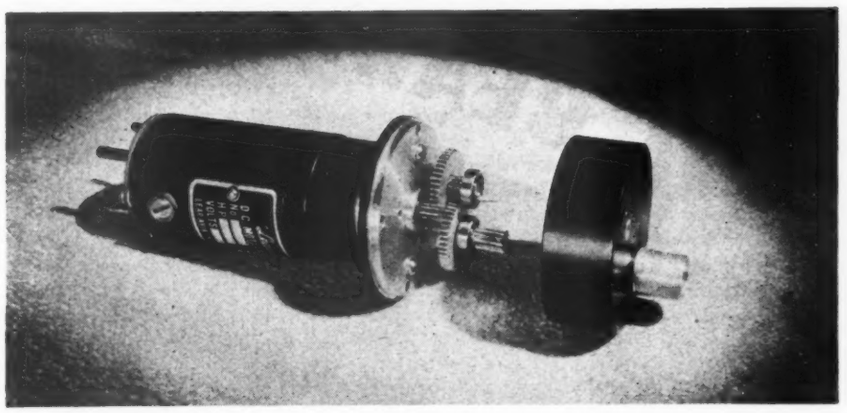
AS THE SIZE of aircraft, both for war and for other purposes increases, problems of remote control are multiplied. Numerous units located at long distances from the pilot and from other control stations have to be positively operated. Direct mechanical control is often not feasible or is virtually impossible. Hydraulic controls, though suitable for some purposes, have their limitations, among them being the possibility that a whole system may be put out of use if gunfire or other mishap causes breakage of one line.

No single system can be made completely immune to injury from gunfire, of course, but certain forms of electrical controls, usually combined with a mechanical drive through flexible shafting, are proving their utility and are finding more and more extensive application.

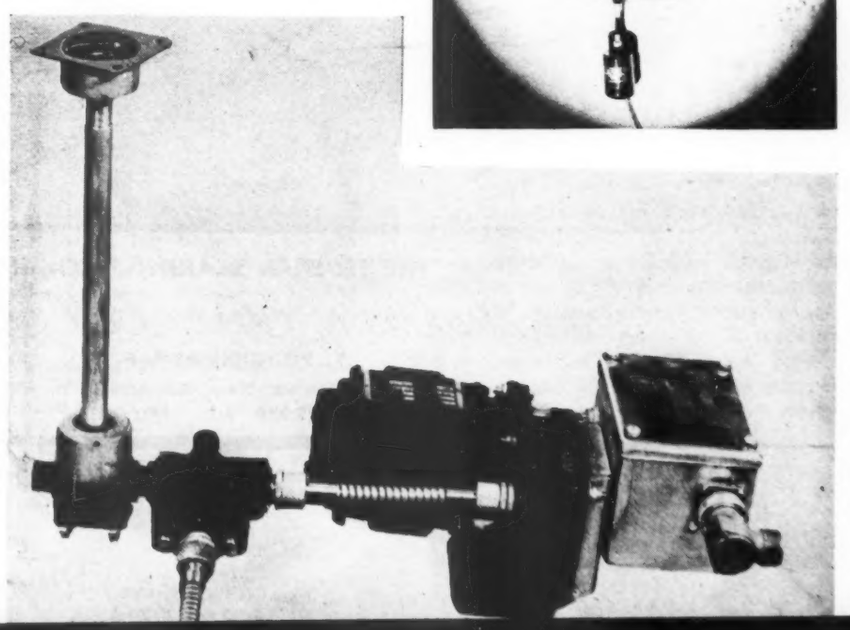
Electrically operated control units are now available in light and compact forms and in combination with magnetically operated clutches which connect and disconnect them instantly, as may be required. This can be made to nullify the effect of over-running armatures having considerable inertia and, when required, permits of controls within a fraction of a degree. This method of declutching also facilitates the use of limit switches without extremely fine settings.

The use of electrical controls is readily made automatic, as by a thermostat, for example, but (and this is often highly important) if the automatic device fails to function as intended, a pair of wires to a manually operated switch provides for manual control should this become necessary.

Where distances are not excessive, it is possible to supplement the electric control with a flexible shaft running from the control station to the part controlled, as between a control station



ABOVE: Fig. 1. Small Lear Avia motor for loop rotation, equipped with a 50-to-1 gear reduction unit and with a "Fastop" clutch. The latter is located back of the flange carrying the gearing and is not seen in this view. Gear shafts are mounted in ball bearings and the serrated end of the final shaft is designed to drive a flexible shaft. RIGHT: Fig. 2. Motor connected through nine lengths of flexible shaft and worm gearing into a ring with seven take-offs for screw jacks to operate flaps in bomber engine cowling. BELOW: Fig. 3. Close view of another assembly which includes a driving motor with its own gear reduction, two worm gear reducers and, at the extreme left, one of a series of screw jacks for cowl flap operation, all driven by Walker-Turner flexible shafting.



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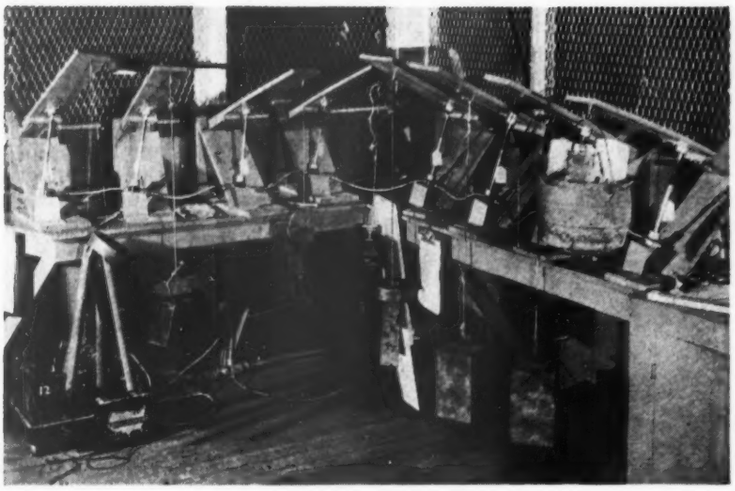
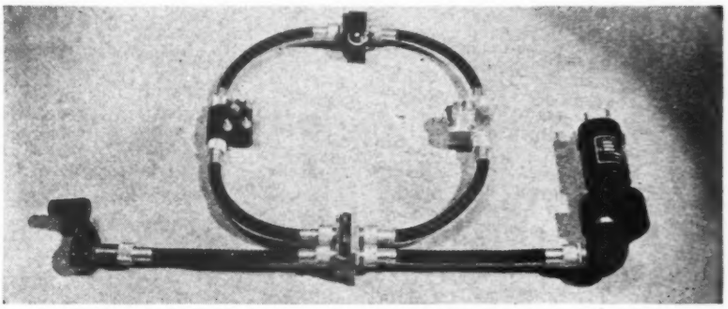


ABOVE: Fig. 4. Experimental test set-up with flexible shafting arranged to operate eight screw jacks simultaneously. Each jack is set at an angle and connected at its upper end with a hinged board carrying at its outer end a 100-lb. weight which must be lifted each time the jacks are caused to lengthen by the flexible shaft and gearing drive. The set-up is intended to simulate the operation of cowl flaps under heavy wind loading. BELOW: Fig. 5. Typical set-up of Lear Avia equipment including a small motor with clutch and gear drive, a right angle bevel gear drive, an H-type flexible shaft coupling, a hand crank and three worm gear take-offs. Much longer flexible shafts would be used, of course, in an actual installation. LEFT: Fig. 6. Portable ground equipment which includes Learadio units of various types and a loop similar to that used in aircraft direction finders.



and a direction finder loop, for example.

Besides electrical units and flexible shafts, control systems often require such supplementary units as gear reducers, angle drives, take-offs from line shafting and screw-operated jacks or thrust units such as are needed for the operation of flaps. All of these and much other related equipment are now in large scale production by Lear Avia, Inc., and are being supplied for use not only in aircraft but for certain ground equipment required by the Air Forces, not to mention other applications.

The lengths of flexible shafting with casings and fittings, though supplied through Lear Avia, are manufactured by Walker-Turner Company, Inc. Since a large number of different units, some of them made in several sizes, are available and they can be applied in an endless number of combinations, only a few can be given consideration here.

Motors are furnished in sizes ranging from 2 to 5,400 watts and can be had in speeds up to 14,000 rpm. In many cases, the motor housing itself incloses a gear reduction (Fig. 1) and motors are usually equipped with a self-contained "Fastop" disk clutch which is magnetically operated and fitted with a brake which can stop the disk within 1/50 sec., according to the makers, from a speed of 8,000 rpm.

When the current is on and the motor is running, the clutch is engaged by magnetic pull, but the instant the circuit is broken, a spring draws the driven disk away from the driving disk and presses it against a braking surface, stopping its rotation almost instantly, for it is light and is then disengaged from the driving disk and armature. The latter can then coast to a stop.

The driven disk is, of course, connected to the part to be operated and. since there is usually a considerable gear reduction between the clutch and the part it drives, the latter may move only a small fraction of a degree after the clutch disengages. Reengagement is rapid but without shock, as there is a slight momentary slippage between the two disks.

A good idea as to some of the set-ups and of the units which enter into them can be had from the accompanying illustrations. One of the most important and extensively applied of these is in flap controls of which several assemblies are used on large bombers. A typical installation of this type (Fig. 2) includes a driving motor with clutch and geared head. From the motor unit, the drive is through a short length of flexible shaft

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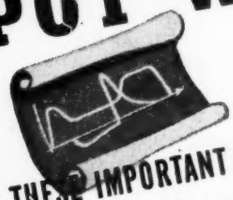

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to a worm and worm gear. Drives are taken off both ends of the worm gear shaft for flexible shafts which extend around inside the engine cowling, forming a complete circle.

Opposite each cowl flap, there is a worm gear take-off. The flexible shaft drives the worm shaft and the drive continues from the opposite end of the worm shaft through another short flexible shaft to the next similar unit and thus through seven identical units back to the first worm gear.

At each take-off, the worm gear shaft is connected to a screw jack which operates the flap. The motor, in this case, is controlled by a thermostat which opens and closes contacts in the control circuit as the temperature varies. The arrangement is such that the motor rotates in one direction to open the flaps and in the opposite direction to close the flaps.

If desired, in such an installation wires can be run to a manually operated switch which can take over should the thermostat fail to operate as intended. These wires and those which supply the motor with power are the only connections needed from outside.

Such an installation requires nine short lengths of flexible shaft, each with its own casing and fittings, eight light worm gear reducers, the driving motor with its own reducer and clutch and eight jacks. The jacks, one of which is shown in Fig. 3, each include a screw working inside a threaded sleeve, the arrangement being such that the sleeve moves outward opening the flap when the screw turns in one direction and vice versa when the screw is reversed.

At one end, the screw is attached through a universal joint with the worm wheel shaft which drives it, and the sleeve at the opposite end of the assembly connects through a ball joint with the flap. This universal action permits the jack as a whole to swing through an angle as the flap opens and closes.

To test an assembly of this type at the factory, a set-up such as that shown in Fig. 4, is used. In place of the flaps are hinged boards extending from supports on which the jacks are located. Hundred-pound weights are hung at the outer ends of the boards and at such a distance from the hinge that the weight produces a 200-lb. thrust on the jack which is purposely inclined at an angle.

All the jacks are connected by flexible shafts which are driven by a motor. first in one direction and then in the other, raising and lowering the weights as the jacks lengthen and shorten in each cycle. For experimental purposes, such tests have been continued for hours on end to impose on the assembly much more severe service than that involved in normal use.

Another typical set-up, insofar as the fittings used are concerned (though longer lengths of flexible shaft would be used in an actual installation) is shown in Fig. 5. The geared head motor at the right has a right angle bevel gear drive connected to it and from this drive a flexible shaft extends to what is called an "H coupling unit" which makes it possible to interconnect four flexible shafts. This coupling contains a pair of spur gears of the same diameter which, of course, turn in opposite directions. As in other gear units, ball bearings are used. One shaft leads to a manual loop rotator. The crank is normally disengaged from the shaft and does not rotate, but when pushed inwardly engages the shaft and permits of manual control, say of a loop, which may be at any of the three worm gear take-off positions.

At other positions, an azimuth indicator might be located or a tuning condenser might be connected either directly or through another flexible shaft. There are, of course, an endless number of such combinations which can be arranged to care for a corresponding variety of set-ups.

Among the applications in ground equipment is the portable unit shown in Fig. 6. This includes an enclosed loop, similar to that used in aircraft installations, interconnected with a Learadio and other related units by flexible shafts and electric cables as shown in Fig. 7, which shows the under side of the cover of the cabinet on which the apparatus is mounted.

As will be seen, the shafts are connected to an H-type coupling unit and run to the loop, to a tuning crank and to tuning units which have to be interconnected. The utility of the flexible shafts and connecting gear drives is apparent. Similar interconnections are made with direction finders, radio tuning devices and related equipment carried in aircraft.

Other similar installations might be described, but those mentioned, together with the illustrations, make it evident how useful the units referred to have proved themselves to be. All, of course, are produced under exacting specifications and with the precision demanded in equipment of this type, and all are giving an excellent account of themselves under trying service conditions.

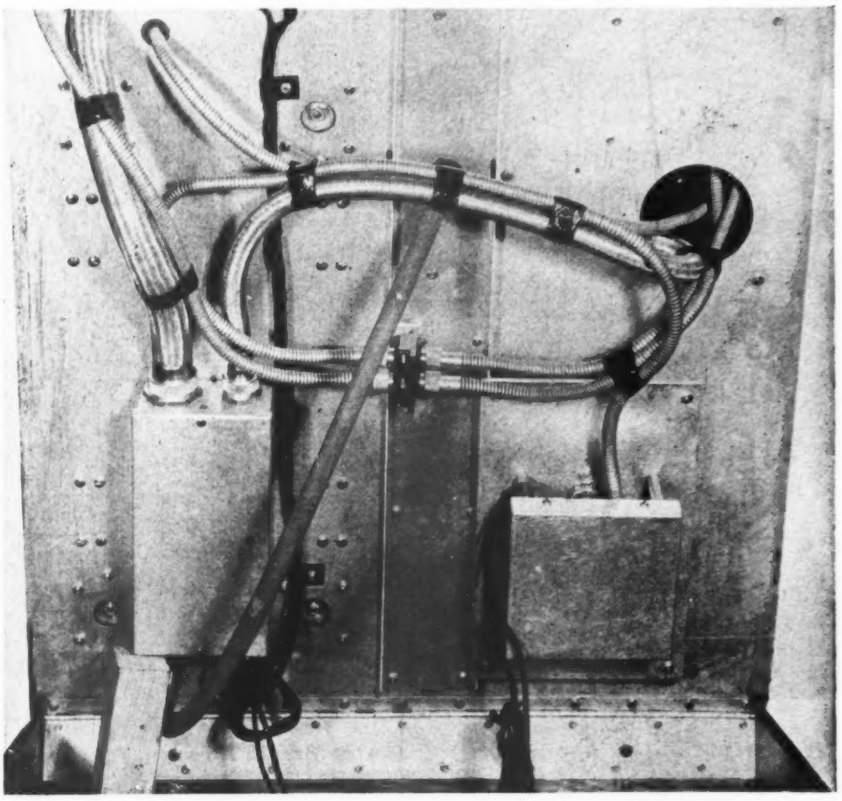

Fig. 7. Underside of the hinged top of the cabinet shown in the preceding illustration. Here are the flexible shafts, joined to an H-type coupling unit and connecting the equipment on the other side of the panel.

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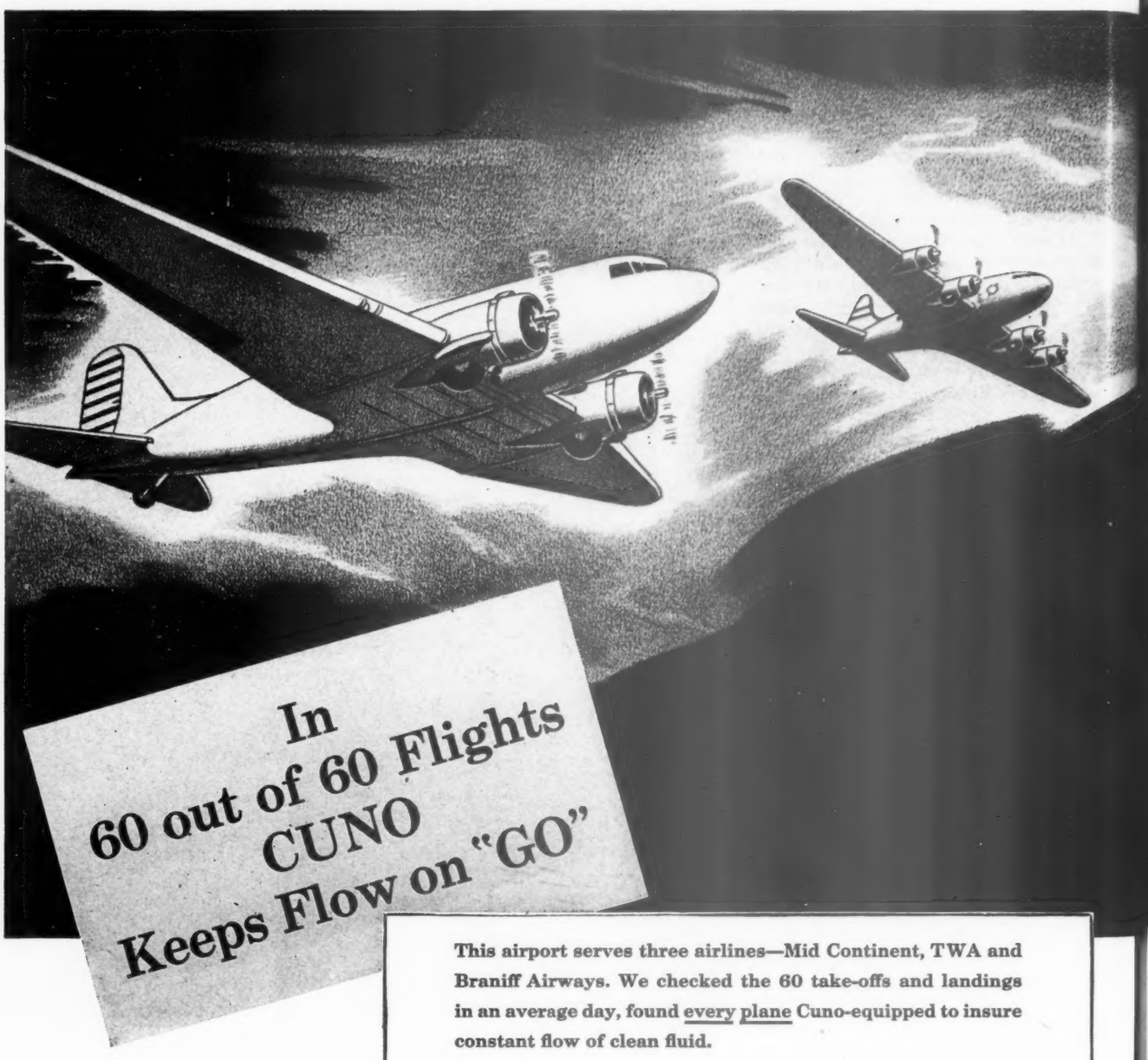

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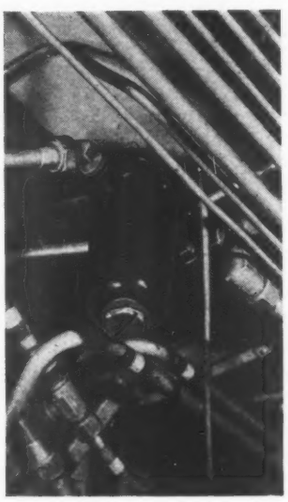

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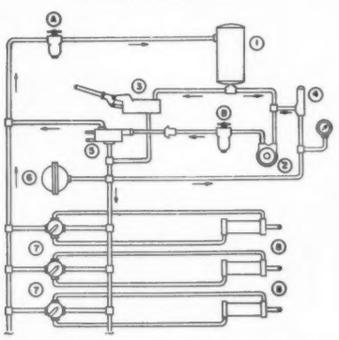
Illustrating
SUITABLE FILTER LOCATIONS



1. Reservoir
2. Engine Driven Pump
3. Hand Pump
4. Relief Valve
5. Automatic Regulator
6. Accumulator (if used)
7. Selector Valves
8. Operating Devices

A and B Filter Locations

The special-design Auto-Klean filter assures positive filtration down to .0035". No solids larger than the spacing to which it is built can pass. Pressure loss is extremely low because the fluid encounters only a momentary restriction as it passes between disc edges. Excess capacity assures unvarying flow at low operating temperatures.

Filter is cleaned without stopping flow by turning the external handle. The non-collapsible all-metal element is thus rotated past stationary cleaner blades which remove all imbedded solids as well as those adhering to cartridge surface.

This installation, in a ½" line, operates at 1000 lbs. per sq. in. pressure.

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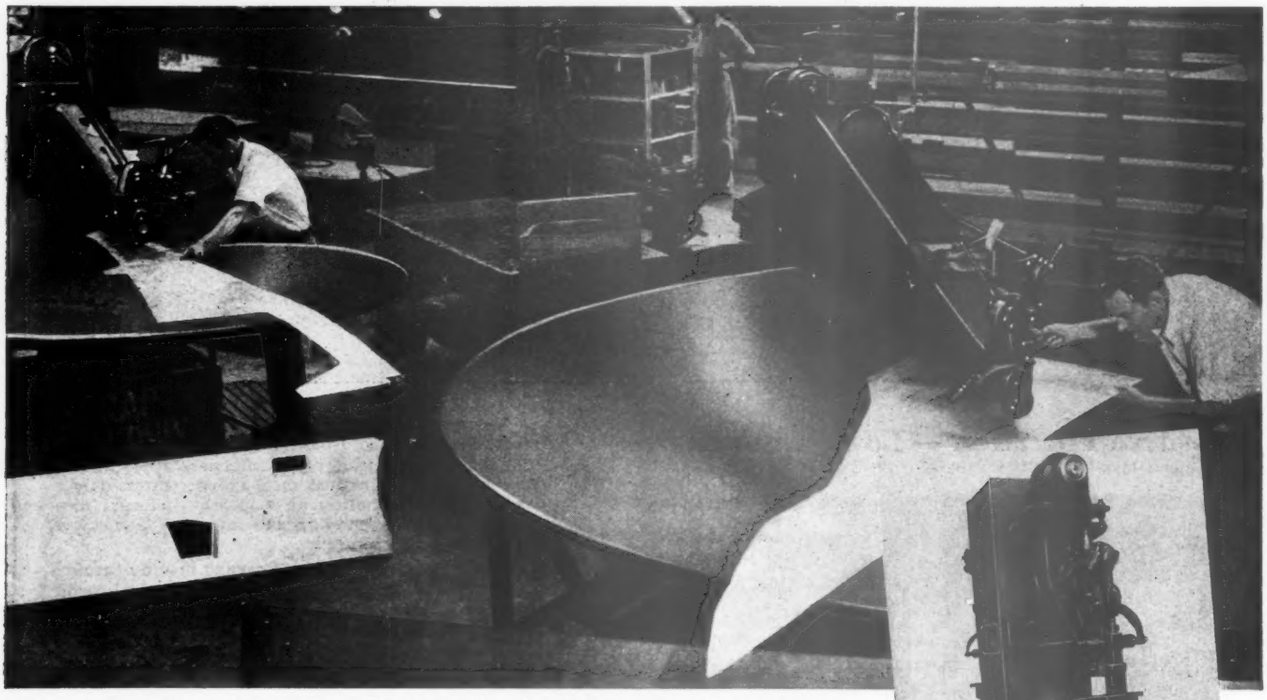
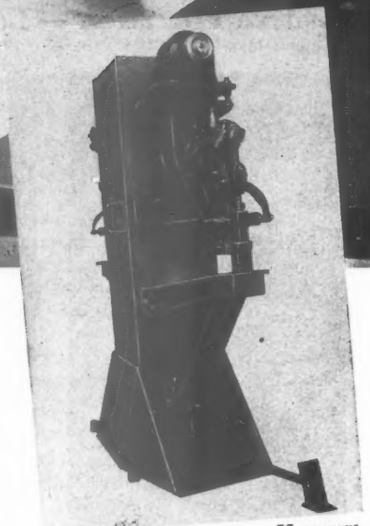
One of the most versatile machines in any plant, your Quickwork may save you months of waiting for new equipment. Write for complete information on attachments available.

Cutting aluminum alloy windshield frames at the Douglas plant. Quickwork construction enables the operator to follow irregular outlines with ease.



Quickwork Deep Throated Rotary Shears in the Douglas Aircraft Plant, Santa Monica, California. Men are cutting irregular-shaped aluminum alloy wing sections.



Quickwork Whiting Power Hammers.

"QUICKWORK" WHITING

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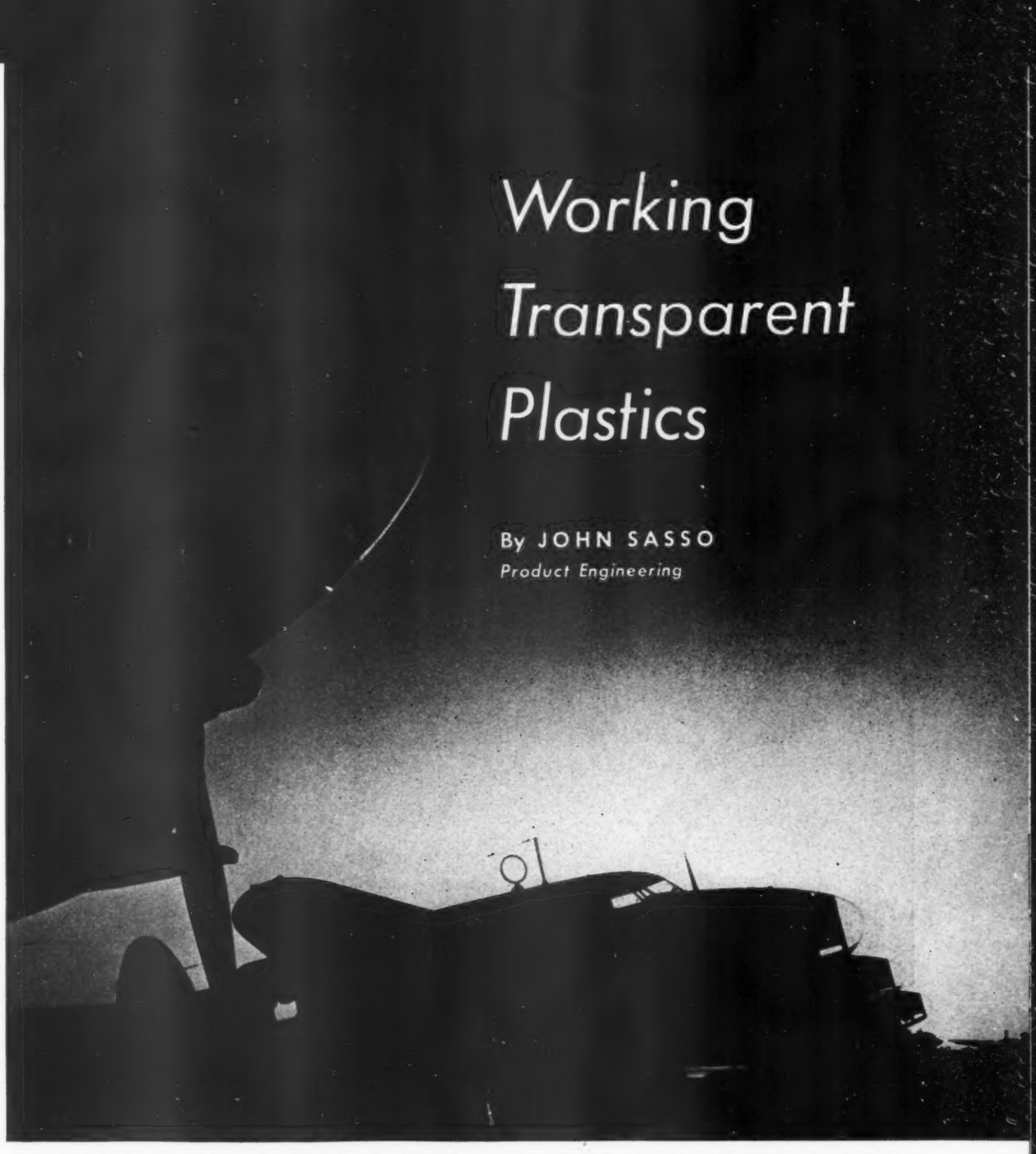
Working Transparent Plastics

By JOHN SASSO
Product Engineering



Transparent plastic nose sections of these Lockheed "Hudsons" point the way for delivery takeoff by the dawn's early light.

PART II—Machining, finishing and repairing of cast acrylic sheets are discussed in this concluding article on the application of transparent plastics to airplane construction. Last month, the methods of forming and joining were described.

THE WORKING QUALITIES of acrylics are similar to those of brass or soft copper and therefore the usual rules of good machining practice apply in their case. Cutting edges of the tools should have no rake and should have a scraping rather than a cutting action. Tools and work should be held firmly to prevent "chattering." When high speeds are used, the acrylic will have a semi-matte surface, which can be brought to a high gloss by wet sanding and buffing. Tolerances of 0.010 can be maintained.

Unlike glass, acrylics may be cut with any of the saws used for wood and metals. Circular, band and jig saws should be moderately fine toothed and should have little "set." For thin material (up to 0.100 in.) a standard hollow-ground rip saw may be used; for thick material, a combination saw with four cutting teeth and one cleaning tooth is used. Saws should run at 8,000 to 12,000 surface ft. per min.

Since the acrylics contain no fillers or plasticizers, they do not gum or dull the saws. If reasonable care is taken to avoid over-heating, no coolant need be used. If a coolant is needed, use water; oil coolants attack the rubber adhesive used on the masking paper.

When a number of formed pieces are to be cut to size, it may prove economical to build a male and female jig or mock-up into which the section can be locked. A hand veneer saw can then be used to

DIMENSIONAL CONTROL

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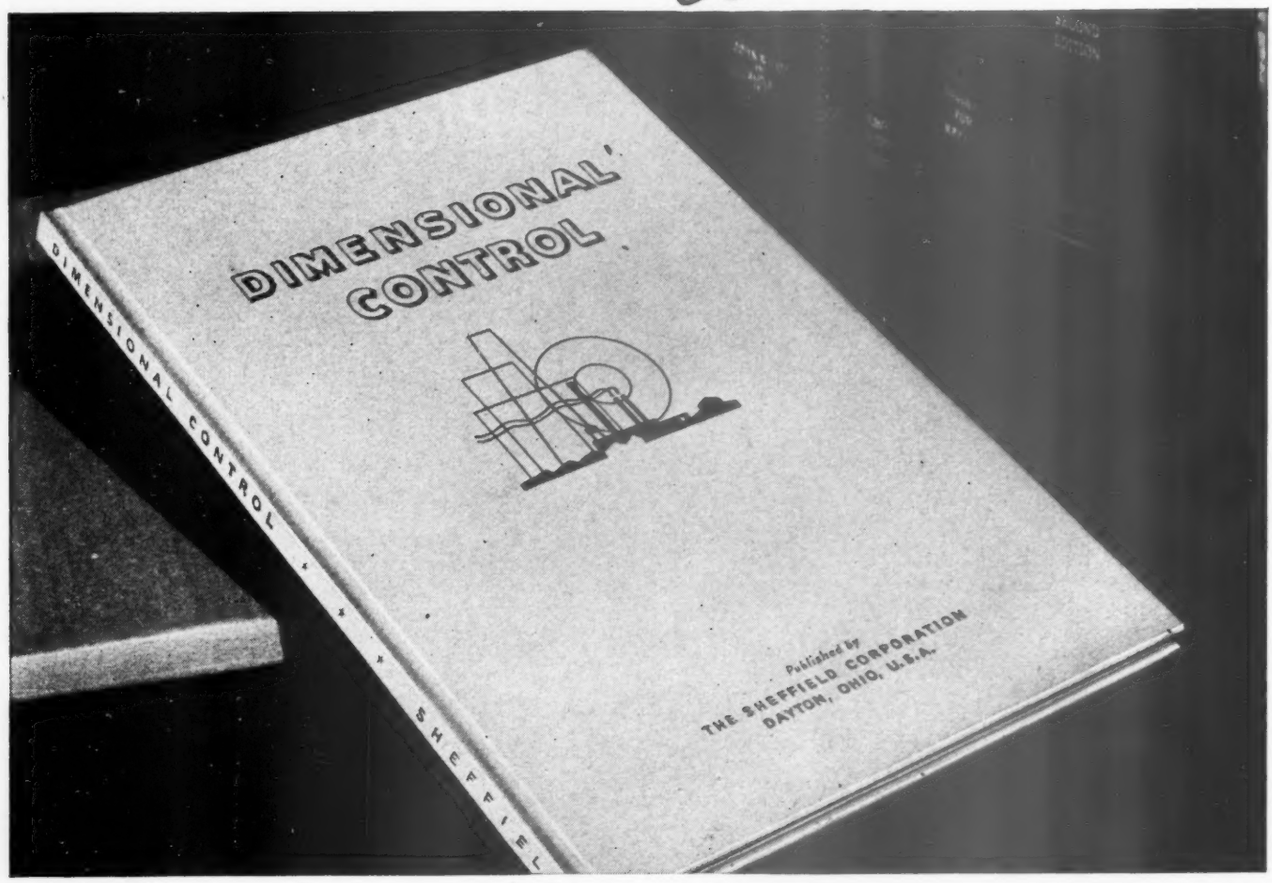

"Dimensional Control" is a new basic text on gages and their use in industrial inspection. It has been written for Engineering students, members of Defense Training Courses, and men in Industry who want a more complete knowledge of this phase of their work.

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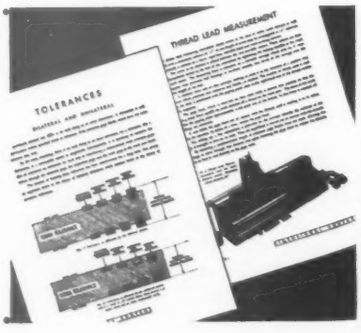


trim the piece accurately and quickly.

Linear tolerances of ±0.030 in. can be maintained in sawing Plexiglas sections under one foot in length; tolerances should be ±0.060 in. for larger sections.

Routing

Routers should run at a high speed, 10,000 to 22,000 rpm. so that the cutter takes a small "bite." It will then not be apt to crack the toe of the rout.

Since the toe plus the depth of the rout equals the thickness of the material, it is not possible in a single routing operation to maintain tolerances in both toe and depth smaller than the thickness tolerances for sheets. Smaller tolerances usually can be maintained, however, in either toe or depth.

When the tolerances of both toe and depth are critical, a second routing operation is necessary—with a corresponding increase in fabricating cost.

Drilling and Threading

The same end mills and drills used for metal are also used. Better results are obtained, however, if the drills are ground with very little lead.

To prevent clogging and burning, the drill should be lifted from the hole frequently and shavings removed. Moderate speeds and light pressure avoid "grabbing" when the drill penetrates. If high speeds are used, a coolant may be required.

Threading can be done without clipping if care is taken not to remove too much material at once. The tap should be backed out often to clear the threads of chips.

Finishing Plexiglas

Before starting to sand, buff or polish, Plexiglas should be cleaned carefully. The buffs and buffing compounds should be free of dirt and grit to avoid scratching the surface. The friction of buffing, sanding or polishing too long or too vigorously in any one spot will generate heat enough to soften or "burn" the surface. This effect is more serious in the case of formed sections, which may shrink back or flatten out if the buff builds up heat in local areas.

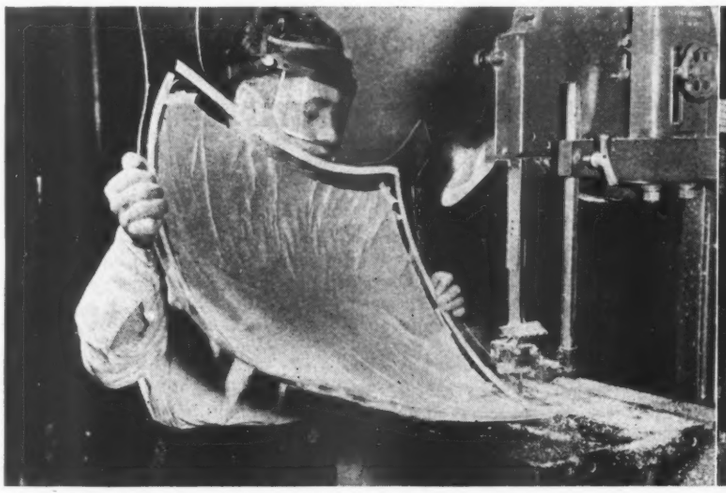
Do not sand unless it is absolutely necessary. However, if surface imperfections are too deep to be removed by buffing, use the finest sandpaper that will remove the imperfections. Sanding with coarser paper than is necessary will only complicate subsequent finishing operations by scratching deeper than the original imperfections.

Usually 320-A wet or dry paper is as coarse as will be required and may be followed—after washing—by 400-A or finer paper. Wet the sandpaper to reduce the heat of friction. Sand a wide area, for if sanding is confined to too small an area, objectionable distortions or "bull's-eyes" will result in the surface. Use very light pressure.

The same general procedure applies to sanding belts and grinding wheels except that the greater danger of heat generation makes the use of a water or oil coolant doubly desirable if not absolutely necessary.

Machine Buffing

Best buffing results are obtained on very soft, open types of cotton buffing wheel. Some of the polishing compounds now available will leave the surface clean so that washing is not necessary. Where these are not used, however,



ABOVE RIGHT: North American uses an ordinary band saw to trim Plexiglas to size. The material cuts like wood and is about as strong. ABOVE LEFT: Sawing Plexiglas at the Bell Aircraft Company plant. BELOW RIGHT: By routing the edges, a Plexiglas panel can be fitted flush with the outer skin of the plane. Here a North American machinist runs a curved piece through a router. BELOW LEFT: A North American inspector examines the surface of a formed Plexiglas section before checking its dimensions in the jig in the foreground. The wide outer flange will be trimmed before installation as shown in the picture above right.

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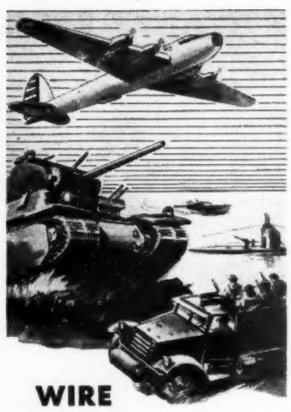

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Fitting a formed Plexiglas panel into its position in the nose enclosure of a Douglas plane.

washing should follow each step in polishing. Use standard polishing compounds composed of very fine alumina or similar abrasives in combination with wax, tallow, or grease binders. These compounds are commonly referred to as coloring compounds and are available in several grades, each of a different color. The finest grade is as coarse as is required in most cases, but the coarser compounds may also be used.

Buffs should run at about 2,000 surface ft. per min.; for example, a 6 in. diameter buff should operate at approximately 1400 rpm.

When most of the scratches have been reduced on the first wheel, buff on a wheel to which only tallow has been applied. When an unbleached cotton sheeting buff is used, it should operate at 3,200 to 3,600 surface ft. per min.

It is also possible to use a large, broad-faced wheel (22 in. to 24 in. in diameter and about 4 in. wide) made from used but clean imitation chamois. The chamois is cut into disks and mounted between face plates. Plain tallow is also used with these wheels and a speed of 3,000 to 3,500 surface ft. per min. is maintained. The material is next brought to a high polish on a buff on which no abrasive or tallow is used. These cleaning buffs may be of imitation chamois 10 in. to 12 in. in diameter running at 8,000 to 10,000 surface ft. per min. or they may be smaller cotton flannel sheeting buffs running at 5,500 to 6,500 surface ft. per min. No further waxing or polishing is required.

For sawed or rough edges sand to a smooth dull finish as described above. To insure sharp, clean edges, it is advisable to buff the edges to a good gloss on the side of a clean, firm wool felt buff (approximately $\frac{1}{4}$ in. thick on a wood or steel disk) operating at 5,500 surface ft. per min. using a paste of water and pumice, magnesium carbonate or similar abrasive. Follow the directions for buffing outlined above. It is advisable to buff lengthwise on all edges and cemented joints. Use a drill rod approximately $\frac{1}{8}$ in. smaller in diameter than the hole to be polished. Split the rod to a depth equal to the depth of the hole plus $\frac{1}{2}$ in. If the inner surface of the hole is rough, wind strips of emery cloth around the rod, gripping in the slot, and apply a fine grinding compounds. When the inner surface is smooth, though dull, wind the rod with a good grade of flannel and use the compounds described above for fine buffing.

Hand Polishing

When buffing equipment is not at hand, a good line abrasive cleaner, such as Noxon, can be applied by hand to remove scratches and other imperfections. Use a damp, soft cloth such as soft diaper cloth, imitation chamois, glove lining or outing flannel. Caution should be taken not to rub too long in one place. Rub with a free, circular motion over a fairly wide area. Several applications of cleaner may be necessary.

When the scratches are removed or considerably reduced, the cleaner should be removed with a damp, soft cloth, and a good automobile wax should be applied. After the polish has been applied evenly, it should be permitted to dry for a few seconds and then rubbed lightly with a dry, soft cloth.

Repairing and Patching

Repairs made under field conditions are at best makeshifts and should not be regarded in any other light. Even when adequate facilities are available, replacing the part may be less expensive than attempting a repair. In general it will be found economical to buff almost any scratched section, but patching may not be justified except on large and complicated formed sections. Besides the considerations of cost, it should be borne in mind that even a carefully patched part is not optically or structurally equal to a new section.

At the first sign of cracking, a hole $\frac{1}{8}$ in. to $\frac{3}{16}$ in. in diameter should be drilled at the end of the crack. This simple operation helps to prevent further splitting by distributing the strain over a larger area.

It is also possible to relieve this strain by lacing the crack with wire. A series of holes should be drilled along either side of the crack but at least $\frac{1}{2}$ in. away from it. Use a strong flexible wire such as aerial wire. This will not seriously interfere with vision and will usually suffice until better repair facilities are available or until a replacement can be made.

A more permanent repair can be effected by patching with a wedge-shaped piece with rounded corners.

The first step in repairing holes is to trim the hole and surrounding cracks to a circle as soon as possible. This will prevent the development of radial cracks and will confine the damage to a minimum area. The hole can quickly be patched in an emergency with wing fabric or thin Plexiglas or cellulose acetate sheeting applied to both surfaces with "dope" or other solvent. Acetone, ethylene dichloride and lacquer thinners will serve to soften the surface so that a satisfactory bond may be obtained. This is at best a temporary expedient however, for the solvent will eventually cause crazing of the plastic surface.

If more time is available, it may be possible to cut out and insert a Plexiglas or even wooden plug which will serve until a permanent patch can be cemented in place, as described below.

Patching

The three guiding principles of patching are: (1) the patch must fit perfectly; (2) a firm pressure must be applied evenly to all edges of the patch while the cement is drying and; (3) sufficient time must be allowed for the cement to dry.

The hole is trimmed to a perfect circle or oval and the edges of the hole given a slight taper. The patch is cut out of material slightly thicker than the section to be repaired and given a more oblique taper than the hole itself. Its edges are heated in an oven or over an alcohol lamp until it is very soft and pliable. Then it is forced into the hole and allowed to cool.

The patch is then removed and both surfaces masked with masking paper. The edges of the patch are allowed to soak in monomeric methyl methacrylate cement or ethylene dichloride until the edges are considerably softened. This may require 30-45 min. for monomer or 2 to 3 min. for ethylene dichloride. The patch is then inserted in the hole again. Because the edges are tapered, pressure need be applied only on one surface and equal pressure will automatically apply

(*Turn to page 255*)

THOUSANDS OF TESTS TO GET THE RECESS RIGHT

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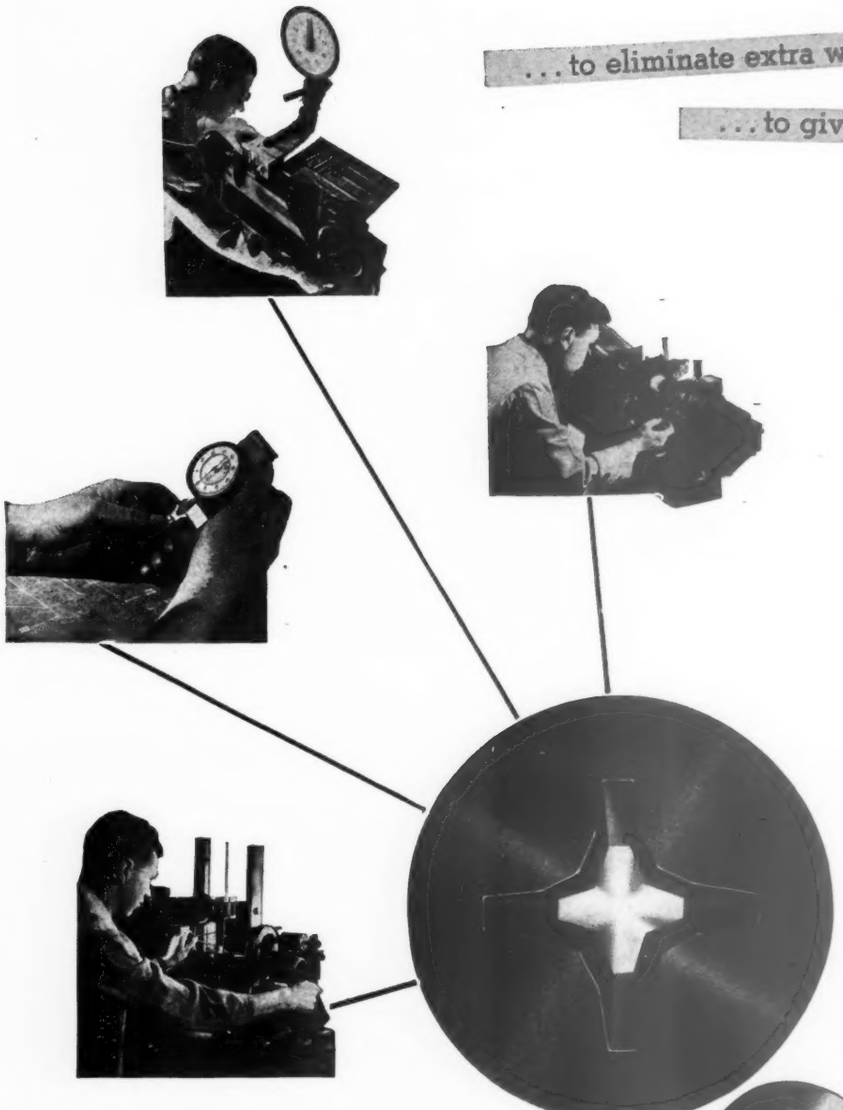

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Production Boosters At Fleetwings

The January issue of AVIATION included an article titled Fleetwings Steps Up Production, which described a number of small, ingenious tools invented by Fleetwings' specialists. Since that time Fleetwings has developed other devices to speed output of aircraft parts. This article gives details on two of the most important of these.

By PERRY ANDERSON, *Fleetwings, Inc.*

IN THE HIGH-ALTITUDE FLYING that is demanded of military airplanes today, it is necessary that the grease used in the ball bearings on control surfaces and in control systems, be such that it does not freeze at low temperatures and thus render the entire system inoperative. Before this fact was realized, thousands of bearings had been packed with heavy grease. To be useable, therefore, these bearings had to be degreased and repacked with a lighter substance. Like many other manufacturers, Fleetwings was confronted with this problem, so we developed our own machine which, to our knowledge, gives faster results than any other available device. Following is an explanation of its operation.

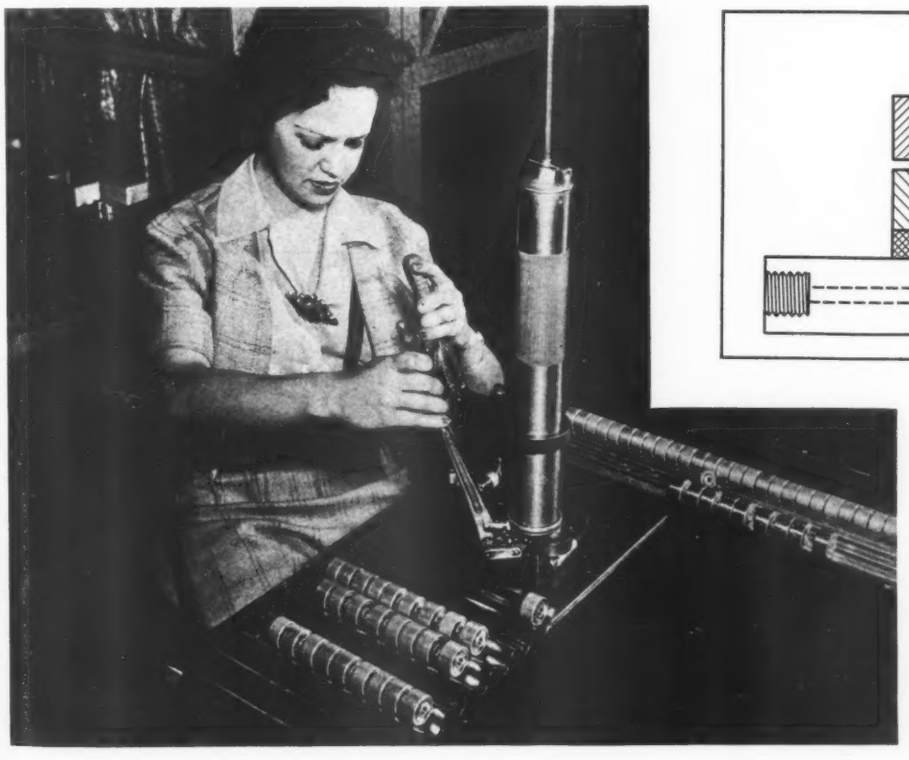
First, the bearings are degreased by dipping them in a naphtha solvent and spinning by centrifugal force from an air motor. They are then dipped and spun again so that any remaining grease will be removed.

The next step, that of repacking, is accomplished by using the machine that we have developed, and which is shown in Fig. 1. The simplicity of this device is apparent. It consists simply of a toggle lever, toggle plunger, and a cone-shaped nozzle, around which is a collar, or seat, which consists of rubber, steel, and leather sections. Grease is pumped from a conventional Alemite gun.

Fig. 2 shows a sketch of the device. The bearing is placed in the machine and the toggle lever pushed forward to the locking position with the top center forcing the bearing against the lower seat which recedes until the bearing is engaged by the lower center. The bearing is thus perfectly positioned and sealed, ready for a shot from the grease gun. The variable length plunger is so adjusted that the two centers secure the bearing firmly at the time that the toggle lever has reached the locked position. The path taken by the grease is indicated by dotted lines in the base.

Fig. 3 shows the set-up that is used for large-bore bearings. The grease enters the lower seat at the point marked "A" and then travels through to the opening at one side of the bearing, "B". Here the charge divides and portions of the grease go through opposite halves of the bearing, with the excess going out through the checking opening, marked "C".

Actual operation of the machine is as



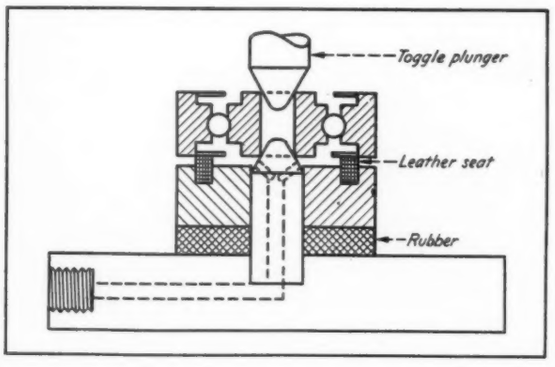
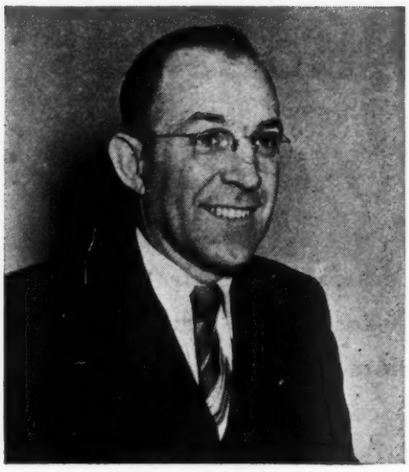


Fig. 2—Sketch shows how bearing is positioned for grease shot.

Fig. 1—Fleetwings' machine for repacking bearings.



PERRY ANDERSON

simple as the device itself. With one easy movement of the toggle lever the grease is shot into the bearing . . . the entire operation consuming less than two seconds. To date, our device has been used for greasing thousands of bearings, of varying sizes, with excellent results.

Another recent Fleetwings development, in the small-tool class, is a device for punching inspection holes in nose boxes for aluminum-alloy control surfaces. This machine saves many precious minutes and represents another means by which Fleetwings is maintaining record deliveries of airplane parts for assembly on many of the leading fighting and bombing planes.

It is obviously not desirable to punch the inspection holes in the flat metal sheet before forming, for considerable distortion would occur during the forming process. Nor is it possible to punch these holes in the formed nose box by using a conventional mechanical punch press. The method used, until a few months ago, called for hand cutting the holes after the piece was formed. This was slow and tedious for the metal in question is .040 in. thick. Furthermore, the manual cutting resulted in rough edges which required filing. More time lost! And even after filing there was a lack of uniformity among the holes, this being inherent in the manual method.

Our solution to the problem is a machine which we have adapted from a pneumatic compression riveter. Fig. 4 clearly illustrates its operation. The nose box is placed in position as shown, and the two dies, male and female, put in place. With one operation of the press, the hole is made—and production of this item is increased more than 300 percent! The dies shown here are of oval shape, but we have also made circular and square pieces, depending merely upon the type of hole needed.

While this machine is of extreme simplicity, it is of invaluable aid to us. So much so that we have made up a number of them. For the many manufacturers who are relying upon the manual method of making inspection holes, we suggest that machines, similar to that described, be tried. Simple to construct and easy to operate, they will help to implement the production of aircraft.

Builders Cooperate On Flight Tests

Additional cooperation among American aircraft manufacturers is reported by Boeing in turning over to Consolidated comprehensive data on organization and procedure of flight testing.

A seven-man flight engineering group from Consolidated, headed by chief test pilot Ernie Stout, visited the Boeing plant in Seattle to familiarize the Southern California test pilots with all phases of the Boeing system developed under the personal direction of Eddie Allen.

The Boeing test unit embraces four closely knit groups; the pilots, all of whom must have engineering background; flight engineers, who plan the tests, compile data in flight and write reports; equipment engineers, who plan preparation of the planes, recording instruments and special test equipment; and data analysts, who compute and present the results.

Fig. 4—Machine for punching inspection holes in sheet metal parts.

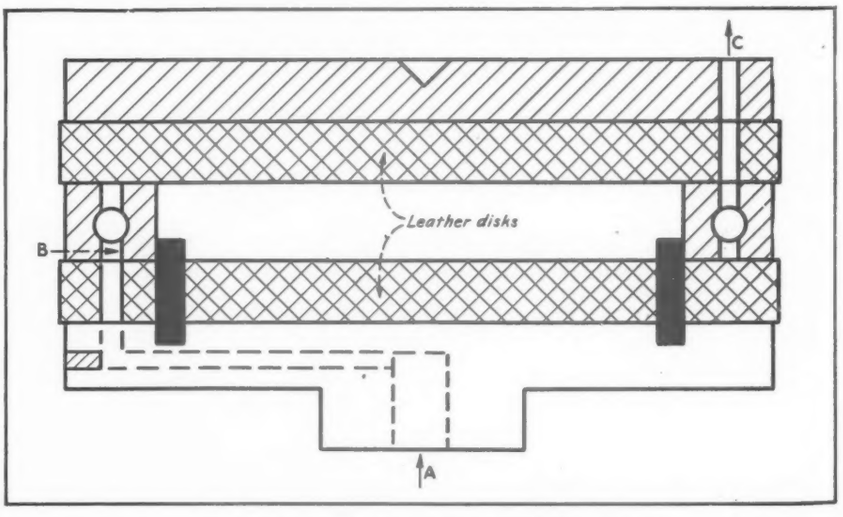
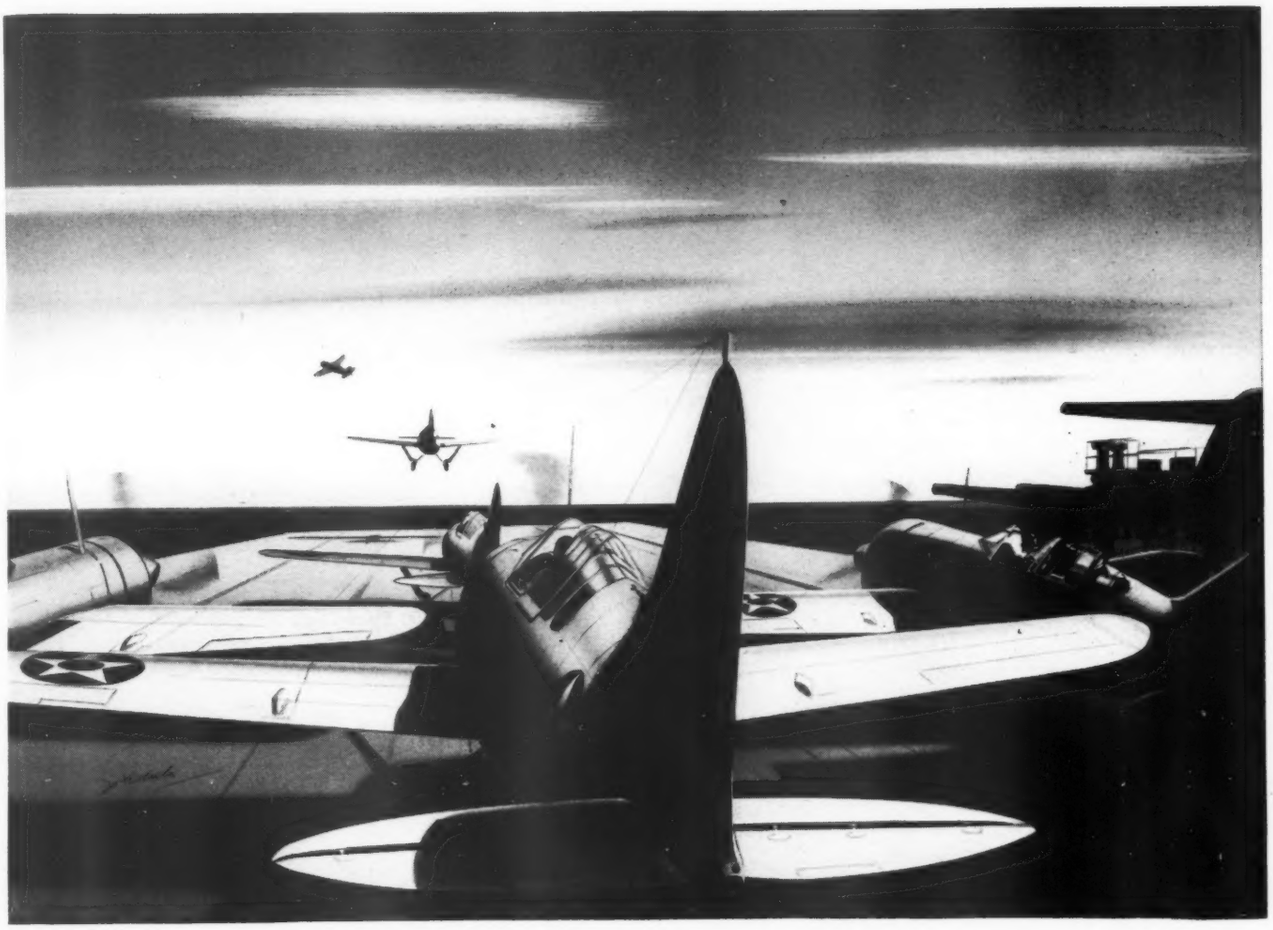
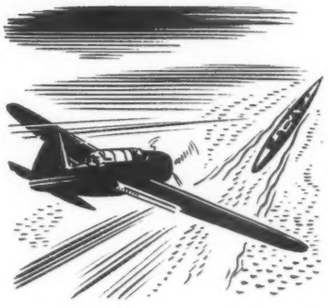


Fig. 3—Set-up used for repacking large-bore bearings.



First off the Deck!



Brewster Buccaneer and Bermuda Dive Bombers will soon augment the striking force of the United Nations.

FIRST off the carriers in the vanguard of attack are the swift and sturdy Brewster Buffalo F2A-3 fighters of the United States Navy. Favorites of the fleet, the short run required for take-off gives them an envied position on the foredeck. Named for the water buffalo of the Far East—a deadly fighter when aroused—Brewster Buffalos are at home over land or sea. Today they are on active duty with Great Britain as well as with the battle line of our own two ocean Navy.

Brewster

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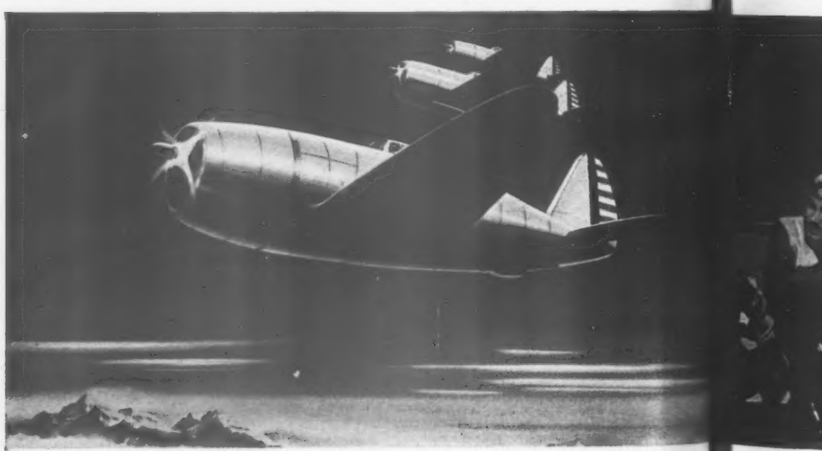
BREWSTER *BUFFALO* FIGHTER

BELL *AIRACOBRAS* (U. S. P-39 PURSUIT)

NORTH AMERICAN *MUSTANG* (U. S. P-51 PURSUIT)

CURTISS P-40F *WARHAWKS*

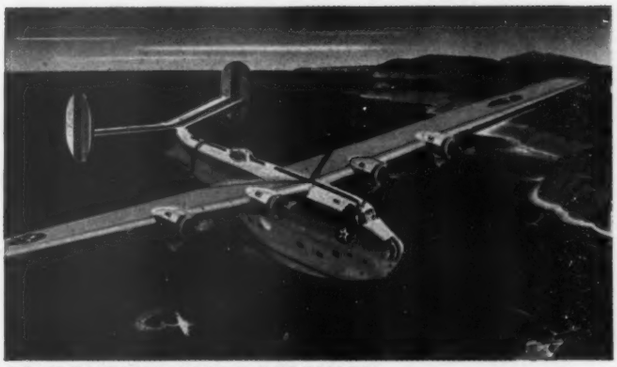


REPUBLIC P-47 *THUNDERBOLT* PURSUIT

MARTIN PBM-1 *MARINER*

LOCKHEED P-38 *LIGHTNING* INTERCEPTOR

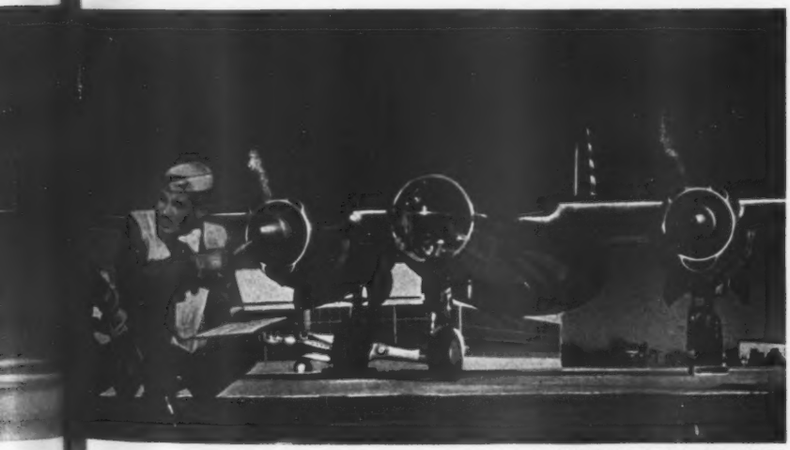
CURTISS SB2C-1 *HELLDIVER*



CONSOLIDATED PB2Y-2 CORONADO

BREWSTER SB2A-1 *BUCCANEERS*

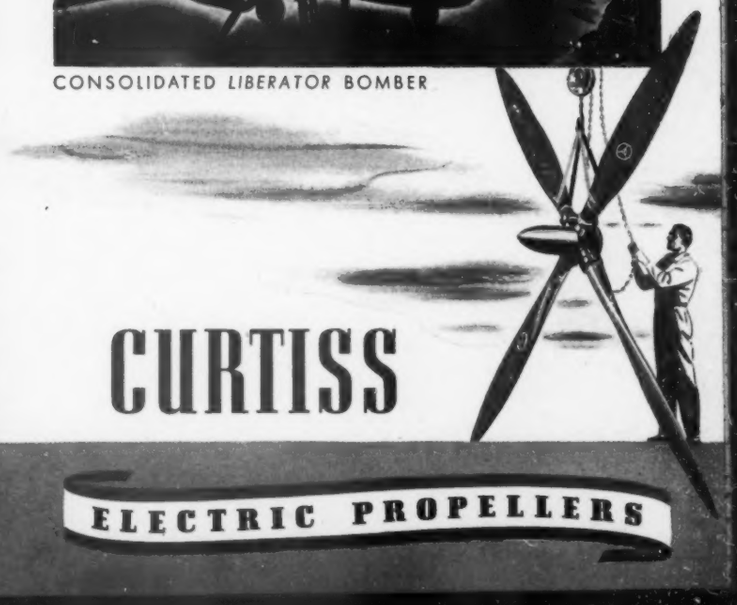
REPUBLIC P-43 *LANCER* PURSUIT



MARTIN B-26 BOMBER

CONSOLIDATED *LIBERATOR* BOMBER

CURTISS C-46 CARGO TRANSPORT



CURTISS

ELECTRIC PROPELLERS

To Those Who Fight

• America's pledge to those who fight is a pledge of ever-increasing production. A swiftly rising tide of weapons, of aircraft, ships, guns, tanks and accessories, is essential to the successful prosecution of the war. Breeze, with all its plants now devoted to production for defense, is meeting the demands of the U. S. Army, Navy and Air Forces, is turning out in quantity high quality Breeze products for service on land, on the sea and in the air. Breeze Shielding, Electrical Connectors, Flexible Conduit and Fittings, Aircraft Armor Plate, and Cartridge Engine Starters, as well as the many other items of Breeze equipment, are today giving dependable service on all fronts to those who fight for Democracy.

Breeze

NEWARK, CORPORATIONS INC. NEW JERSEY

Radio Ignition and Auxiliary Shielding • Multiple Circuit Electrical Connectors • Flexible Shielding Conduit and Fittings • Conduit Junction Boxes.

Cartridge Engine Starters • Dichromate Cartridge Containers • Internal Tie Rods • Propeller Pitch Controls • Elevator and Rudder Tab Controls.

Flexible Shaft and Case Assemblies • Aeroflex Jr. Flexible Instrument Lines.

Tachometer, Fuel Pump and Remote Control Drives • Ammunition Rounds Counters • Radio Tuning Units.

Generator and Ignition Filters • Exhaust Gas Analyzers (Fuel-Air Ratio Indicators) • Flexible Metal Tubing • Resistance Type Thermometers • Swaging Machines and Tools • Armor Plate.

Stainless Steel Division: Pioneers in the design and development of stainless steel structures and fabricated products.

Forged Cylinder Head Developed by Wright

New technique speeds production, increases power output, saves weight.

THE FORGED CYLINDER HEAD, along with the methods devised for machining it, recently made available to the entire aircraft engine industry by Wright Aeronautical Corp., after five years of intensive research and development, constitutes a tremendous advancement in the design and construction of aircooled internal combustion engines.

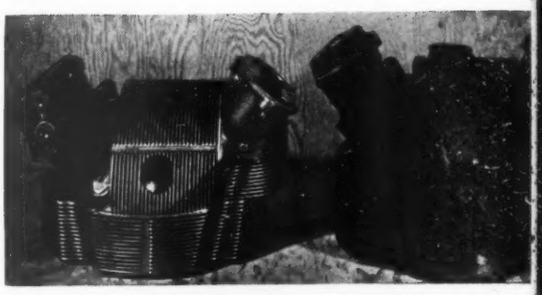
Myron B. Gordon, vice-president and general manager of Wright Aeronautical Corp., states that the new head will allow a 12 to 15 percent increase in the power output of an engine without any increase in weight. He also pointed out that the new technique would speed up production of heads, estimating a 40 percent saving in material rejections under the new method.

The strength of the new heads, achieved through finer and uniform grain structure in the metal, permits much higher compression ratios and vastly increased power output per cylinder without increase in weight. In tests, the forged heads have withstood hydraulic pressures double the maximum for cast cylinder heads now in general use.

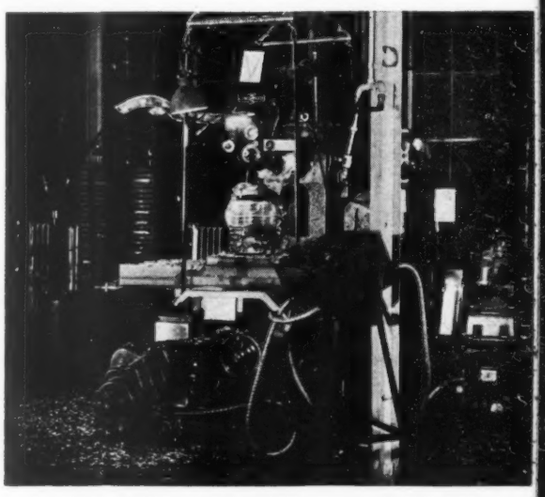
In fabricating the forging, aluminum bar stock is extruded, then sections of the extruded bar are pressed in a die to final shape. Nine separate drop hammer operations are eliminated by adaptation of the extrusion-die process to the forged cylinder heads, thus leaving the critically scarce drop hammers free for other uses in the war production program.

The cooling fins, customarily cast as an integral part of the head, on the forged heads are cut by high-speed milling machines which permit closer finning

(*Turn to page* 263)



The forging at the right is made from a section of an extruded bar pressed to final shapes by dies. Cooling of the finished head at left is improved by closer finning and a 35 percent increase in the conductivity of the metal.



LOWER LEFT: This is one of the special milling machines designed in accordance with specifications supplied by Wright engineers cutting the fins on the new machine forged cylinder head developed by Wright Aeronautical Corp. LOWER RIGHT: Forged heads are double the strength of cast heads, weigh less and run cooler. These specially designed milling machines turn at speeds approaching those used in woodworking. RIGHT: This is one of the first experimental milling machines used in the new process, designed for cutting fins around the exhaust port. The new technique permits the enlargement and improvement of intake and exhaust ports, resulting in increased performance.

Perspective Drawings Speed Plane Assembly

Three-dimensional drawings are now being used extensively to simplify and speed up assembly line operations. These so-called production illustrations also partially answer the skilled labor shortage problem by quickly introducing the new worker to his job on the assembly line.

RUEL SHORT, former wholesale grocery salesman, after but three months on the job, and aided by production illustrations, is an efficient assembler at the Douglas Aircraft Company. He had no training, other than that given by experience while working from illustrations similar to that shown here.

WILLIAM E. KUHNLY checks a production illustration of a center section leading edge assembly as LaVeene T. Larson and Vernon D. Henry rivet a bulkhead on the line at the Vega plant.

PRODUCTION ILLUSTRATIONS may well come under the heading of vital production tools in the aircraft industry today. Their cast of features is familiar to all who have seen sales and service manuals pertaining to all sorts of mechanical products, but their application to assembly line operations is new and vitally important.

Simply defined, production illustrations are cutaway perspective drawings of assembly sections applied to aid the worker in visualizing the job he is working on. While the value of this function is proved in actual practice, the drawings serve also as instructional devices for the assembly worker. They contain a precise listing of parts and tools needed for completing the assembly and clearly indicate the sequence of operations to be followed. To further add to their usefulness, even the jig set-up is described in the illustration.

Production illustrations serve to supplement blueprints for those who use them, and take the place of blueprints for the untrained. What is gained here is that every assembly worker has a simplified and understandable picture of the job before him, enabling him to do the work with greater speed and efficiency.

Dimensions Unnecessary

One of the further differences between the production illustration and the usual engineering drawing is the former's total lack of written dimensions. There is no need for all of this confusing detail on the assembly line because the part is already formed. It makes no difference to the worker whether or not the part is $\frac{1}{4}$ in. or $\frac{3}{32}$ in. thick, so long as it is readily identifiable by code or general shape to correspond with the drawing. All the worker needs to know is where and how it should be attached, and what tools to use in doing so.

For the untrained, blueprints of electrical and plumbing installations are

particularly baffling. To search through dozens of engineering electrical prints to find installation data is a tedious and time consuming task. Orderly drawings with none but the essential assembly data shown present an ideal working tool in these instances. Furthermore, there just aren't enough people experienced in blueprint reading to meet the requirements of the vastly expanding aircraft industry. The time necessary to train new men is too precious to so expend if a reliable method can be used instead.

Tests Show Time Saved

Because of the multitude of factors involved, it is impossible to estimate the total time saved as a result of application of these production illustrations. However, as an instance, the Vega division of Lockheed ran a test of their value in the early stages of their adoption on the Vega assembly lines. The first sketches were drawn free hand in isometric, reproduced on a ditto machine and distributed to the shop. Two crews, one with a production illustration, and one without, were assigned to assemble the left and right hand wing spar respectively. The crew working with the sketch completed the first unit in 1.9 hr. The crew without a sketch completed the first unit in 5.4 hr. The inspection department, in a test, used about the same proportion of time. This time differential is greatly magnified on functional installations such as electrical or plumbing.

In a check at Douglas, the observed time taken by an experienced man for a given job was 9.15 hr. A new man without previous experience or supervision did the job in 7.2 hr. with the aid of a production illustration. With further experience, and a sketch available, this new man would reduce the time of operation considerably further.

To demonstrate the use of production illustrations in practice, the accompanying sketches involve the assembly of the lower door of a bombardier's compartment of obsolete design. Fig. 1 of the series shows the assembly of basic structural members of the door. Each numbered arrow denotes one of the operations and in actual practice the drawing includes the number and name of each part involved in each of the operations.

Fig. 2 shows the assembly of the frame, using the members assembled as per Fig. 1. The circled numbers indicated the proper sequence of the riveting operations. This sequence is also listed in the instructions normally appearing on the sketch along with the list of parts.

Six additional assembly operations are shown in Fig. 3, include the outside skin riveting operation. In these production illustrations, certain parts are pulled out of position where necessary for clarity.

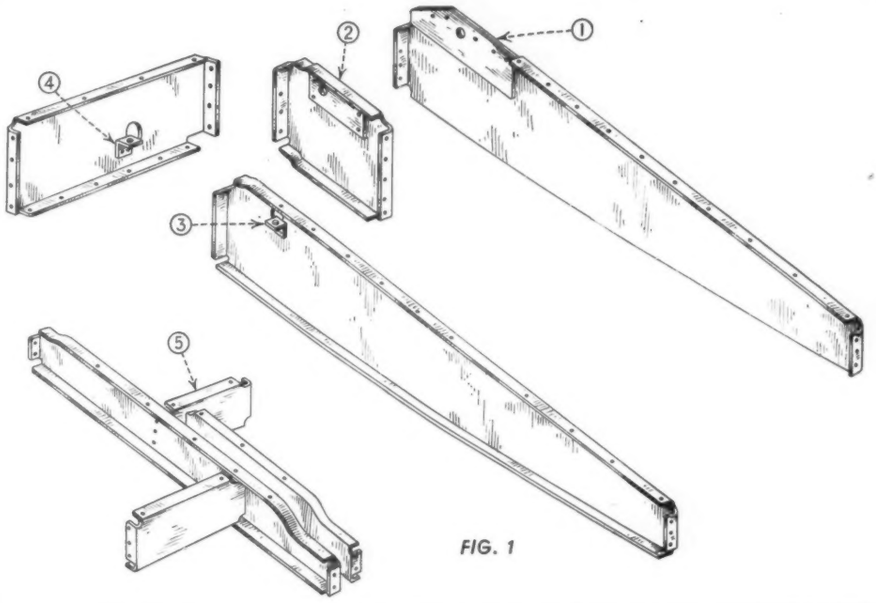


FIG. 1

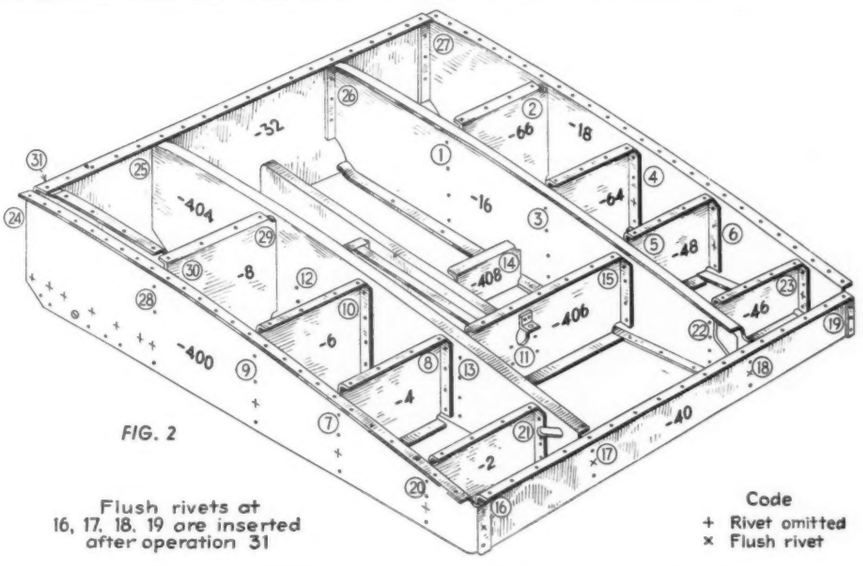


FIG. 2

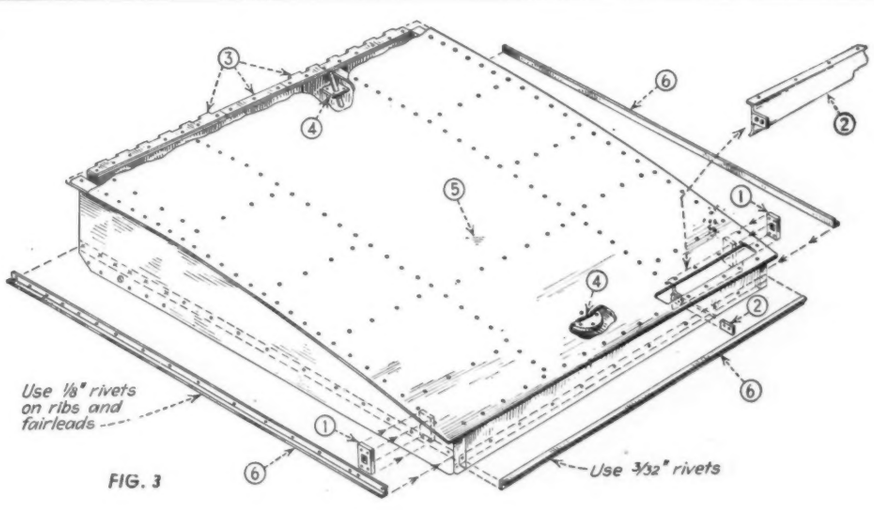


FIG. 3

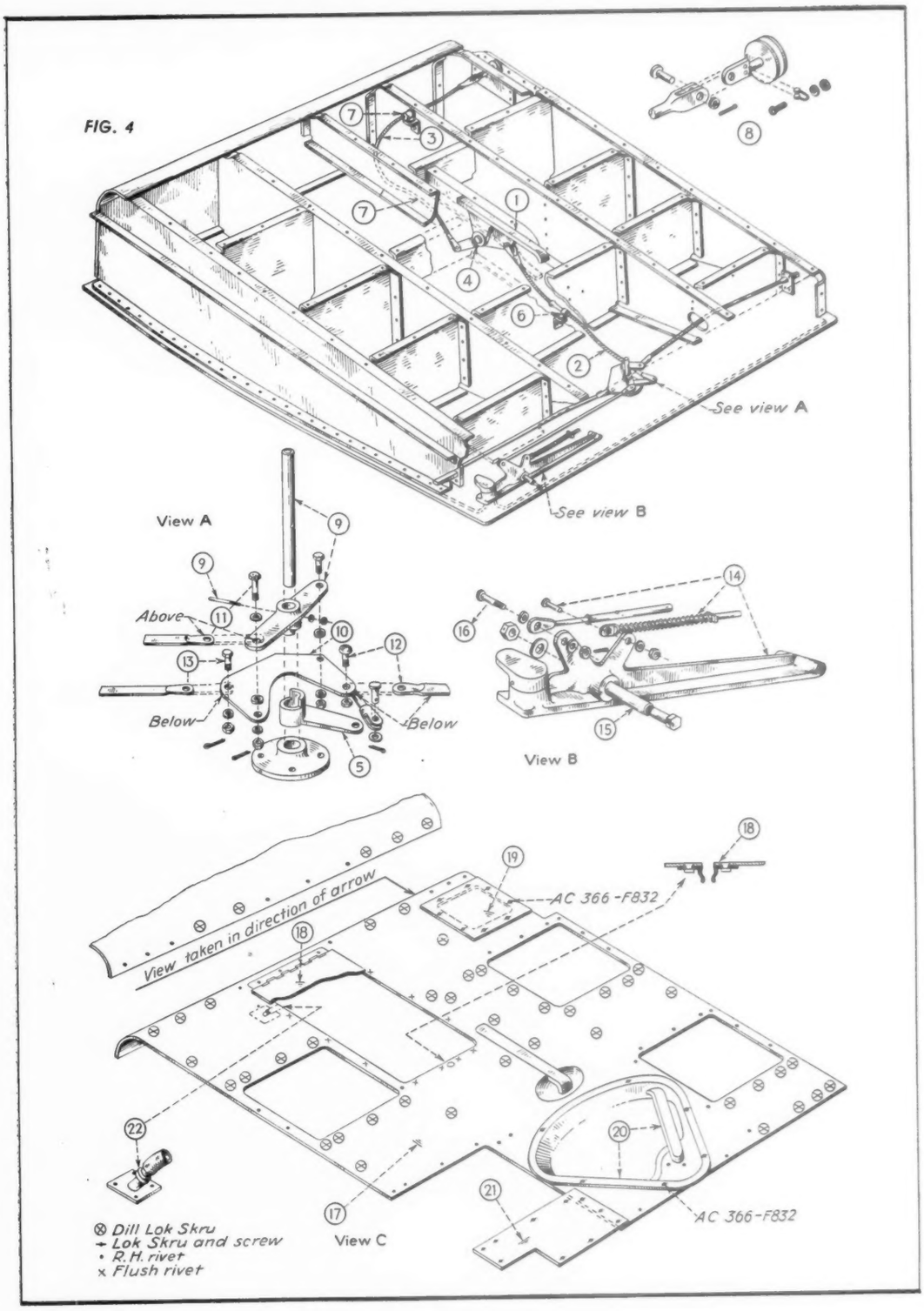


Fig. 4 shows the door in an inverted position on the skin side, in which position the emergency handle mechanism is installed. The enlarged detailed drawings of this mechanism is shown in views A and B. After this handle is assembled, the top cover plate shown in view C is assembled and attached to the door. This completes assembly of the door. The order of operations is, as usual, indicated by eireled numbers.

While production illustrations make it possible for the relatively untrained to begin producing immediately, it takes skilled personnel to make the illustrations. Those with combined engineering and artistic training are best qualified, with emphasis on the engineering. The mechanical draughtsman with long experience in two-dimensional work needs extensive training in the three-dimensional field. The Art Center School in Los Angeles worked closely with Douglas in the training of illustrators, and other schools such as the University of California are now conducting courses in this specialized art work.

American Mathematical Society Meets

By DR. ARTHUR KORN

The American Mathematical Society had in the meeting of April 3–4 at Columbia University a Symposium on Aeronautics with two important addresses: *Theory of Wing-Flutter*, by Dr. Theodore Theodorsen, and *New Approach to the Three-Dimensional Wing-Theory*, by Dr. R. E. von Mises.

Theodorsen's theory of wingflutter is based on the two-dimensional wing-theory with the following assumptions:

1. We obtain a first aproximation considering wings of infinite span.
2. The thickness of the profile and the angle of attack are very small.
3. The motion of the surrounding matter is considered as irrotational motion of an incompressible fluid.

DR. R. E. VON MISES
Harvard University

4. The velocity at the trailing edge remains finite.
5. In the case of unsteady motion a vortex sheet is formed in the wake of the plane of such a kind that each vortieity-element remains invariably at its place, or at least aproximately so.

Under these assumptions the mathematical problem could be treated (Wagner, Sedoff, Kuessner, Kárman and Sears, Theodorsen). In the case of harmonic oscillations of the wing the mathematical problem could be solved by means of the theory of Bessel—respectively Hankel-functions; the lift could be calculated and introducing the value of the lift in the equations of the motion of the wing, it was possible to find out under which conditions proper vibrations of the wing (wing-flutter) would occur. Theodorsen has worked out this theory to such an extent, that it could be applied to practical applications, and a satisfactory agreement could be found between theory and experiment.

A new approach to the three-dimensional wing-theory, to the theory of wings with finite span, was given in the second important address by R. E. von Mises. In the wing-theory there is the very obvious endeavor to consider the two-dimensional theory as a first approximation but there is a very disagreeable difficulty. In the case of finite span one can never have a circulation around the wing, if the surrounding matter is considered as an incompressible fluid with irrotational motion and one excludes infinite velocities; the assumption of vortex-sheets will not remove this difficulty; vortex-spaces must be considered, which may have their origin at the ends of the wing, and they may be more and more neglected, the greater the span is.

A first theory has been given by Prandtl, but there are in this theory some new arbitrary assumptions which better would be avoided. Von Mises gives a new approach to the three-dimensional theory avoiding these arbitrary assumptions, departing from some convenient formulas giving the velocities of a fluid, when they are given at the boundary, analogous to Cauchy's formulas in the plane, and moulding the whole problem into a rigorous mathematical form.

DR. THEODORE THEODORSEN
Langley Field, Va.

NEW METAL STRETCHING PRESS

This 150-ton metal stretching press developed and constructed by the Hydraulic Press Manufacturing Co., Mount Gilead, Ohio, offers extreme versatility in the forming of sheet metal with wood or metal dies. The main platen to which the dies are attached is actuated by two double-acting rams, controllable independently. The two gripper jaws, each 84 in. long, are traversed mechanically by two electric gear motors and traversed hydraulically by two double-acting rams. The gear motors are used for positioning the clamps before stretching. The clamp jaws can be adjusted angularly up to 15 deg. in a horizontal plane, and can be made to move in toward the main platen during the stretching operation. An overhead structure, not shown in photograph, is provided to hold dies for reverse draw work. Tests were made with Kirksite dies furnished by Goodyear to form the bottom plate and keel of a pontoon. The results were said to be satisfactory despite the difficult shapes involved.

Weight Engineers Meet in Chicago

SAWE Meeting draws record attendance with well-rounded program

THE SOCIETY of Aeronautical Weight Engineers, Inc., held their second national conference, April 27-29, at the Palmer House, Chicago, Ill.

The three-day session was pronounced highly successful by attending officers and members because of the volume of work accomplished and the number of problems solved through mutual agreement.

The total attendance of 53 men included representatives of 22 aircraft manufacturers, 8 airlines, 6 accessory manufacturers, 1 engine manufacturer, the Air Forces, Civil Aeronautics Administration, 2 scale manufacturers, and AVIATION Magazine.

The first day of the meeting was devoted to military projects, the second to airlines and accessory projects and the last day was given to general technical projects. The following projects were presented and discussed during the meeting:

Airframe weight statement
Volume II—*Accessory Weight Handbook*
Seal of Weight Approval

NAVY "E" TO GRUMMAN AIRCRAFT

The Navy "E", traditional symbol of excellence in the performance of duty, was awarded the Grumman Aircraft Engineering Corp. and its workers for aircraft production. Grumman builds the "Wildcat" fighter and "Avenger" torpedo-bomber. Participating in the presentation ceremony were James V. Forrestal, Under Secretary of the Navy; Artemus L. Gates, Assistant Secretary of the Navy for Air; and Rear Admiral John H. Towers, Chief of the Bureau of Aeronautics, who made the speech of presentation. L. A. Swirbul, executive vice-president and plant manager (right of Navy officer in photo) and Russell T. Robarge, chairman of the Grumman employees organization (behind microphone) accept the award.

Gun Turret Weight Statement
Value of a Pound
Volume III—*Design Weight Handbook*
Volume IV—*Operator's Weight Handbook*
Exchange of Weight Data
Residual Fuel and Oil
Relationship of Cost Control and Weight Control
Center of Gravity Limit Requirements
Minimum Flying Weight
Revision to Air Forces and Navy Design Specifications
Service Pick-up
Air Carrier Weight Control
SAWE *Journal of Technical Papers*
Expected and Guaranteed Engine Weights
Propeller Weight and C.G. Data
Accessory Weight Data

Some of the more significant projects which were brought to a successful conclusion at this meeting will be brought up to date and discussed in full in future issues of AVIATION.

The society was organized on a local basis in 1939 in Los Angeles, but rapidly grew to a national organization with chapters throughout the country. It is founded on the belief that a constructive contribution can be made to the future development of aircraft by the application of research to weight control and to estimating procedures.

At this crucial time when every pound saved in the weight of an aircraft structure means additional range and the ability to carry heavier loads of ammunition and armament, the SAWE is performing a vital function in expediting the interchange of ideas and information in this swiftly progressing science.

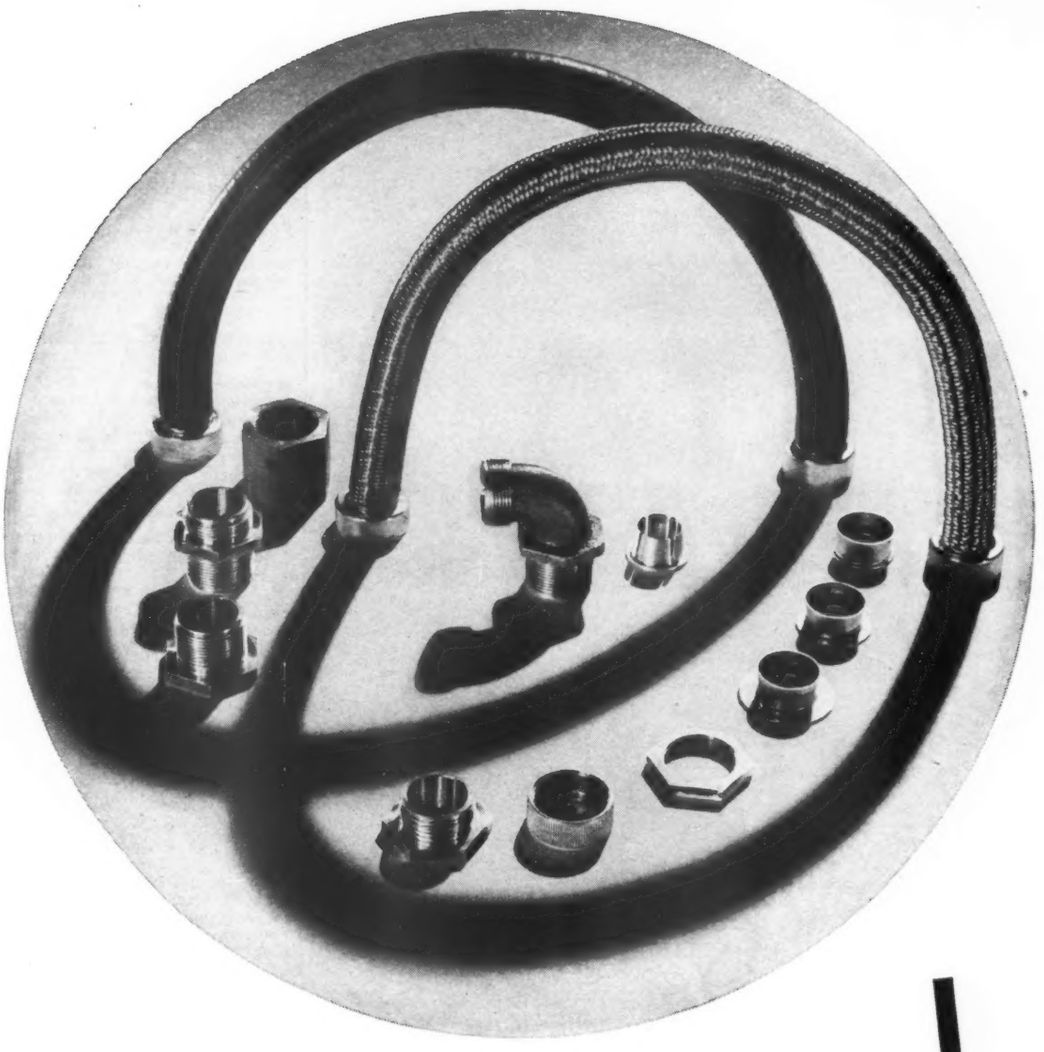
The SAWE national officers for 1942 are: chairman, Donald R. Watson, Fleetwings, Inc.; secretary, William H. Downs, Republic Aviation Corp.; treasurer, C. Fred Comstock, Fairchild Aircraft Division. In addition, the society's organization includes five regional divisions, each of which has its own chairman and officers.

At the recent meeting, the society decided to hold its third national conference in Dallas, Tex., next year.

Thread Standards Adopted

The American Standards Association has issued standards covering general purpose Acme threads, with an angle of 29 deg. between sides of the thread; the 29 deg. stub thread; the 60 deg. stub thread; and a modified square thread with a 10 deg. angle between sides of the thread.

Because of widespread application of these threads in industry and the importance of standardization to war production the British Standards Institution is considering making similar adoptions.



Save ASSEMBLY TIME!

We can save you valuable time in assembling "American" flexible low-tension shielding conduit and fittings

THIS IS an opportunity to save considerable time in the assembling of fittings and low-tension flexible shielding conduit.

The same men who produce both the conduit and fittings . . . the people who know the product inside-out . . . will perform this assembly job for you—to your exact specifications.

Simply send us the complete specification. We'll tell you by return mail how we can handle your assembling to *your* best advantage.

American Metal Hose makes a complete line of fittings and accessories for American Flexible Low-Tension Shielding Conduit. Both fittings and conduit conform to A-N, A-C and N A F specifications.

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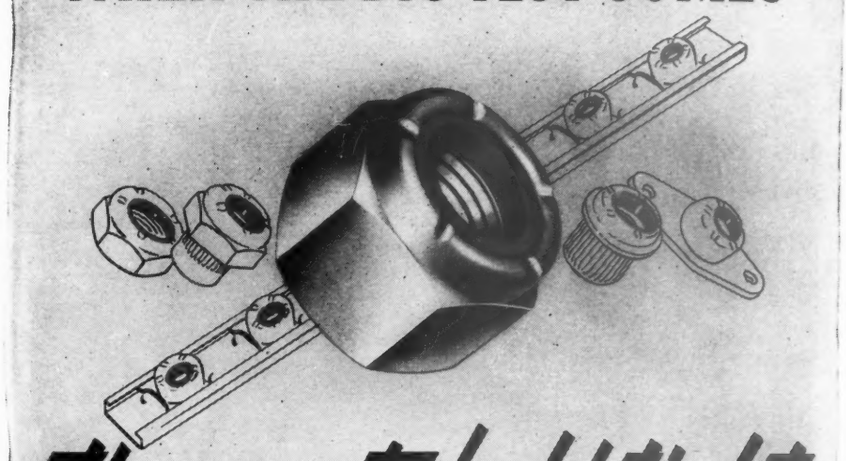
ANACONDA from mine to consumer

American Metal Hose

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • General Offices: Waterbury, Conn.
Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ontario*

The Boeing B-17 Flying Fortress is fastened throughout, at important structural and secondary connections, with Elastic Stop Nuts.

WHEN THE BIG TEST COMES



these nuts hold tight

Bolted connections on military airplanes call for lock nuts that hold with a grip which is positive and yet resilient . . . a grip that withstands the complex vibrations, the stresses, and the shocks, of high-speed maneuvering . . . a grip that protects the ships and the men who fly in them.

Evidence that Elastic Stop Nuts meet these all-important requirements is found in the fact that they are used for vital structural and equipment fastenings on **every** military airplane built in the Western Hemisphere.

There are more Elastic Stop Nuts on American airplanes, tanks, and other war equipment, than all other lock nuts combined.

THE RED LOCKING COLLAR . . . SYMBOL OF SECURITY

ELASTIC STOP NUT CORPORATION • 2320 VAUXHALL ROAD • UNION, N. J.

Elastic Stop SELF-LOCKING NUTS and AIRCRAFT FITTINGS

HELP AMERICA • KEEP 'EM FLYING

» Catalog will be sent on request
. . . and nuts for testing are readily available.

Review of Patents

Airplane mechanism, No. 2,277,173. Herbert Wagner, assignor to Junkers Fluzzeng-and-Motor-en Werke Aktiengesellschaft, Dessau, Germany. A system of air channels within a wing structure adapted to discharge air over the ailerons and landing flaps which increases their effective operation.

Power means for operating aircraft control surfaces, No. 2,277,378. E. C. Wells, assignor to Boeing Aircraft Co., Seattle, Wash. A pilot control surface is manually operated which in turn actuates the power mechanism to operate the main control surface. This permits operator to maintain the "feel" of his ship without overexertion.

Airplane, No. 2,278,562. A. E. Raymond, assignor to Douglas Aircraft Co. Inc., Santa Monica, Calif. This invention provides ailerons which have a longitudinal movement in addition to the usual pivotal movement. This increases the maneuverability of the ship and adds to the safety factor, according to claims.

Propeller and de-icing means therefor, No. 2,278,640. Joseph Berge, assignor to Jaeger Watch Co., Inc., New York, N. Y. Apparatus for de-icing propellers which provide means for feeding an antifreeze solution to the leading edge of the propeller.

Aircraft construction, No. 2,278,557. J. W. Overbeke, assignor to Glenn L. Martin Co., Baltimore, Md. A hydraulic booster for controls which is so constructed as to be attachable to ships previously provided with a manual control system. This booster is actuated by movement of the hand control and only operates after the control surfaces have been moved a predetermined distance by hand.

Airplane gear, No. 2,278,910. E. M. Bertram, assignor to Brewster Aeronautical Corp., Long Island, N. Y., A self-locking and unlocking retractable landing gear arrangement which uses a double acting lock member which moves with the gear and is locked or unlocked by the initial movement of the hydraulic arm.

Airplane landing gear, No. 2,279,074. S. C. Stearman, assignor to Transair Corp., San Francisco, Calif. A steering mechanism, for the retractable tail or nose wheel of an airplane, which is hydraulically controlled and is completely out of the way of the wheel permitting the retraction of the wheel. The steering mechanism is automatically locked when the wheel is retracted.

Controllable pitch propeller, No. 2,280,374. R. Chilton, assignor to Wright Aeronautical Corp., Paterson, N. J. A feathering multiple blade propeller having a bearing mounting which will permit improved assembly and disassembly methods to be used; also the hub has been lightened and otherwise simplified.

Feathering propeller, No. 2,280,713. E. Martin, et al, assignor to United Aircraft Corp., East Hartford, Conn. A feathering propeller which has two ranges of feathering. The first of which is controlled in one direction by hydraulic means and in the other direction by centrifugal means. The second controlled in both directions hydraulically.

Driving mechanism for air rotors especially aircraft sustaining rotors, No. 2,281,203. H. F. Pitcairn, assignor to Autogiro Co. of America, Willow Grove, Pa. A hydraulic means is used to drive a pair of reversely turning propeller blades near the end of the main rotor of an autogiro. This arrangement does away with the torque problem and permits the use of a single rotor.

Military airplane, No. 2,281,673. V. J. Burnelli, assignor to Central Aircraft Corp., Keyport, N. J. A construction which greatly reduces the average height of the fuselage in the wing area and has the fuselage in this area in the shape of the wing reducing wind resistance.

Welding Gas Conservation Imperative

Demand for oxygen and acetylene for welding has pyramided so rapidly in war production industries that, despite additions and expansions of plants making the gases, it is reported a critical situation faces the industry unless widespread conservation measures are adopted.

Illustrative of efforts already being made are those of Air Reduction Sales Co., whose salesmen have for some time been serving as "educators" striving to eliminate wasteful shop practices and promote more rapid turnover of shipping cylinders.

Tips should be kept clean—congested tips are inefficient, waste time and gas.

Hose is made of rubber and must be conserved. Keep hose clear of sparks and slag; even minute burns cause serious wasteful leaks.

To assist them the organization has prepared a list of recommended practices, based on observations of correctible conditions in oxyacetylene welding and cutting shops, which have proved extremely valuable in insuring an uninterrupted supply of gas and in reducing costs. In one such case it was found that a shop was wasting some 25 percent of its oxygen through an accumulation of what had been regarded as "insignificant losses."

The recommendations include the following:

1. *Use the proper size torch tip.* A No. 2 tip instead of a No. 1 for cutting ¼-in. plate consumes 10 to 20 percent more oxygen, 16 percent more acetylene.

2. *Do not use excessive pressures.* This, one of the most common malpractices, is usually done by inexperienced operators who believe they thereby get a more efficient flame, or to save a trip to the pressure chart. Manufacturers' rated pressures are the most efficient for average conditions. And when more speed is desired, the new high speed machine cutting tips cut faster without consuming additional oxygen.

3. *Close cylinder valves when torch is not in use.* If only the torch valves are closed, rising pressure in the hose may force leaks.

4. *Check hose and connections for leaks.* They may be little, but a 1/32-in. diameter leak in hose operating at 100 lb. will waste 290 cu. ft. of oxygen in 24 hr.—more than a tankful. The hose should be checked periodically by immersing in it water while under pressure, to show up leaks. Soap and water will reveal leaks at connections.

5. *Use correct diameter hose.* Hose that is too small requires higher gage pressure to secure sufficient flow, causing unnecessary strain and promoting leakage.

6. *Use short lengths of hose.* Unnecessarily long hose also requires higher pressure. Also, the surplus lengths, though useless for the job, are subjected to unnecessary wear and tear.

7. *Use all the gas in each cylinder before connecting a new one.* Use every cylinder for all it is worth before disconnecting it. Larger shops can eliminate interruptions of work to change tanks by manifolding gas cylinders, or by installing pipe lines.

8. *Keep cylinder inventories low.* The old custom of keeping plenty of reserve cylinders must be abandoned, for it "freezes" them at a time when rapid turnover is imperative. Gas suppliers are cooperating by providing frequent deliveries. You can help by ordering fewer cylinders oftener, and by keeping reserves of cylinders at a minimum.

9. *Return empty cylinders promptly.* Idle cylinders are production slackers.

10. *Don't leave torches burning when not in use.* It may seem troublesome to be constantly re-lighting the torch, but if it burns idly for even as little as 3 min. each hour, it is wasting 5 percent of its gas consumption. Five percent of last year's industrial oxygen consumption was 360 million cu. ft. Let's use those 1,636,000 tankfuls for welding and cutting, not for heating the air.

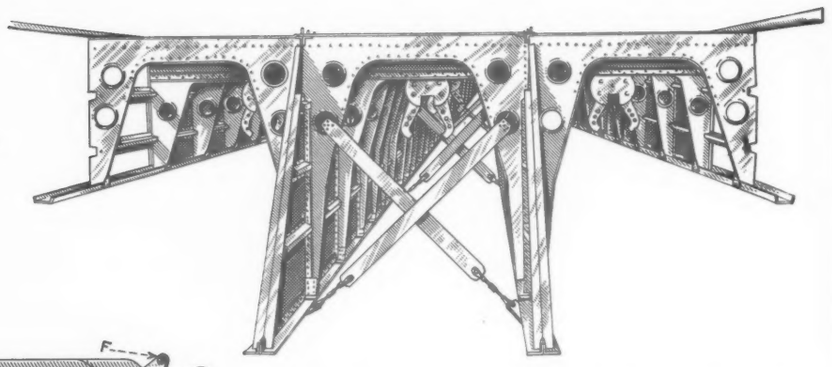
11. *Keep tips clean and free from carbon and slag.* An unclean tip is an inefficient tip. Congested orifices nullify the value of using proper pressures and speeds, resulting in lower efficiency and consequent waste of gas.

12. *Don't abuse cylinders.* A damaged cylinder must be taken out of circulation. It contributes nothing while undergoing repairs.

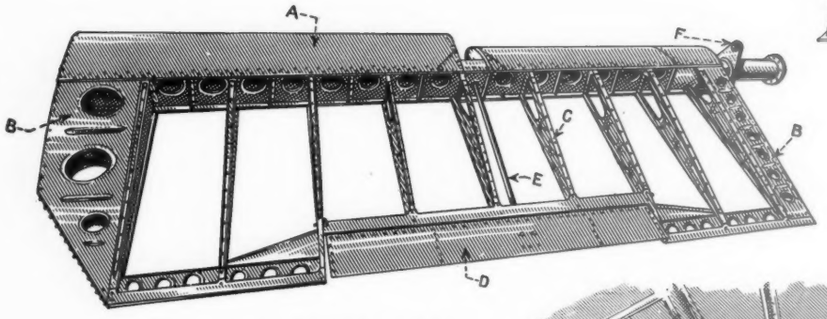
13. *Handle hose with care.* Because hose is made of rubber, it must be made to last as long as possible. To ensure this, it must be protected against mistreatment which promotes leaks. Therefore; keep hose out of range of hot oxide and sparks; wash off oil and grease, which ruin rubber; place a plank on each side of the hose where it crosses truck runways; store any hose stocks in a cool, dark place; and when a hose is damaged, cut out the bad portion and splice the ends together with standard splicing nipples

SALVAGE VIA MATCHING "V's"

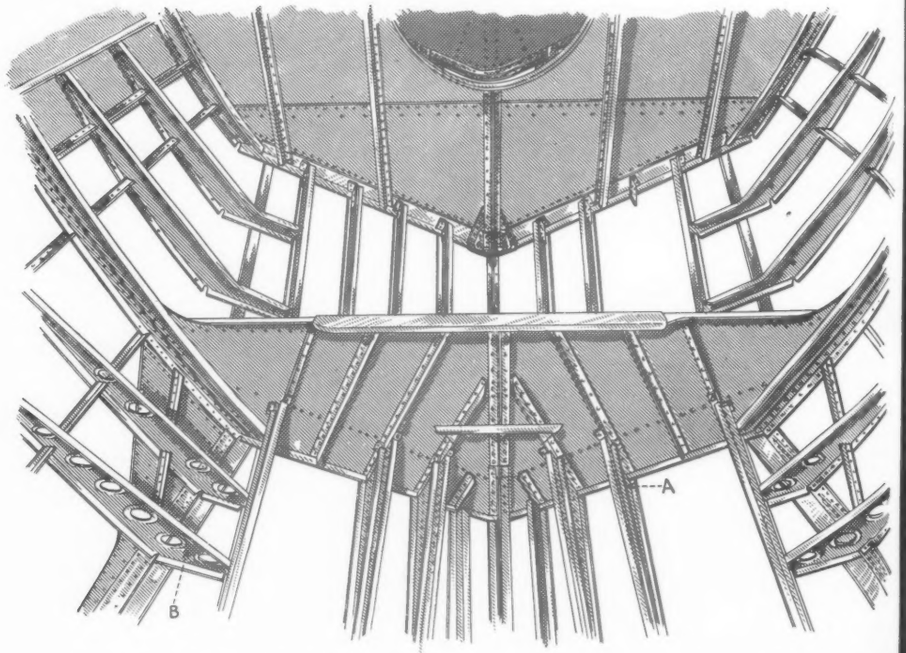
Wright Aeronautical Corp. employee empties machine tool scrap collector into salvage receptacle marked with V of same color combination, thus keeping same type of scrap material segregated from others as part of program to speed and increase salvage operations.



The main bomb racks of the Short Stirling are 42 ft. 7 in. in length and extend right across the floor of the fuselage. In the end view, shown above, the racks are seen to be divided by two longitudinal girders into three compartments, each of which houses a series of bombs, the actual number remaining a secret, by means of the attachment hooks shown.

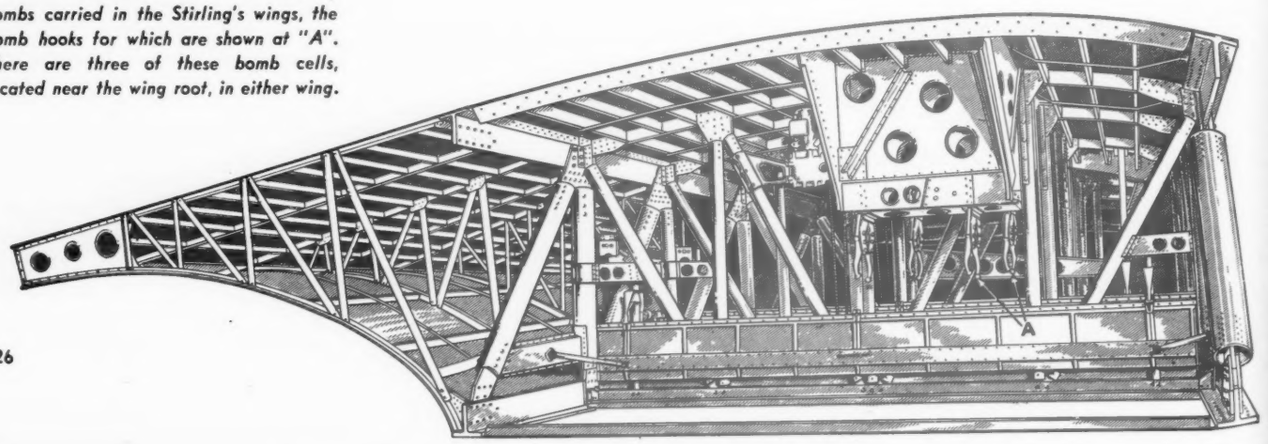


The elevator of the Consolidated B-24 has a D-section leading edge. This is shown at "A" in the sketch above. Attached to this D-spar are reinforcing aluminum alloy plates "B" at either end, supported by the end ribs which give rigidity to the structure. These end structures and the ribs "C" are covered by fabric. The aluminum alloy trim tab "D" is actuated by the control tube "E" and the entire elevator is moved by the horn "F".



At the second step in the hull of the VS-44-A, the bulkhead looks as shown in the drawing above. This view is looking aft, downward, in the ship, and shows the bulkheads which are used to replace the longerons in the bottom. These bulkheads "A" are triangular in shape and are so designed to take the load which is imposed at the edge of the step. In order to do this, the base of the triangular section is placed at right angles to the bottom of the ship at this point. The members along the sides at "B" are to take the loads concentrated at the intersection of the side and bottom of the hull.

Part of the wing structure of the Short Stirling is shown below. Basically a 2-spar structure, the spar flanges are of extruded T-section with the top and bottom flanges connected by a tubular N-girder arrangement. The design follows closely that of the Short flying boats, with this difference: the inter-spar bracing is now of the same tubular form as that of the spars themselves. In the flying boats the bracings were in the form of tie-rod tension members. An interesting structure is the reinforcement to accommodate the heavy bombs carried in the Stirling's wings, the bomb hooks for which are shown at "A". There are three of these bomb cells, located near the wing root, in either wing.



Grumman Uses VICKERS

HYDROMOTIVE CONTROLS

Vickers Hydromotive Equipment is used on many of the most modern airplanes. The Grumman Carrier Fighter illustrated here is representative.

Vickers Hydromotive Controls are high pressure oil hydraulic controls that are so widely used because they do the job dependably, smoothly and accurately . . . no matter how severe the service.

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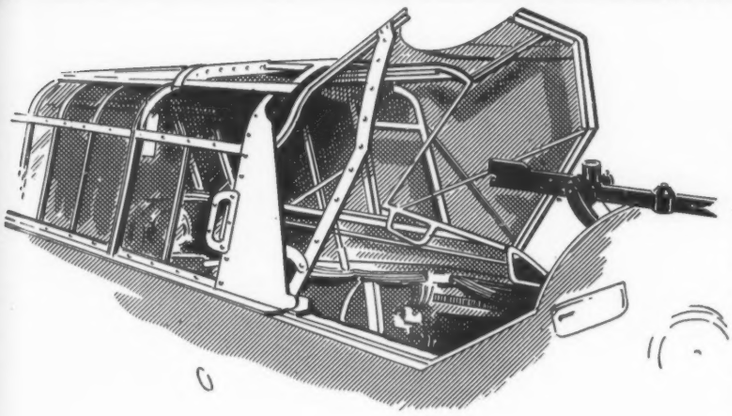
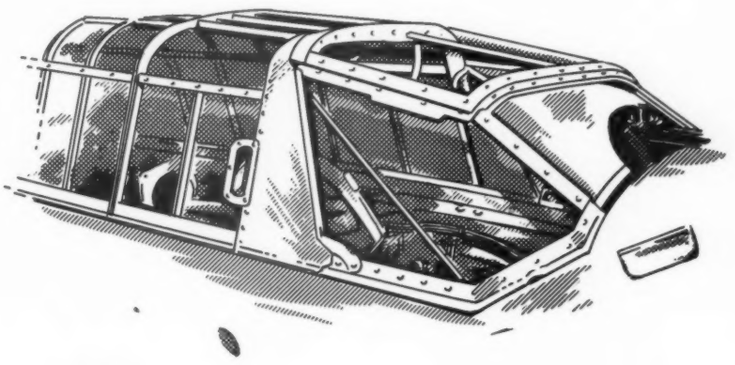
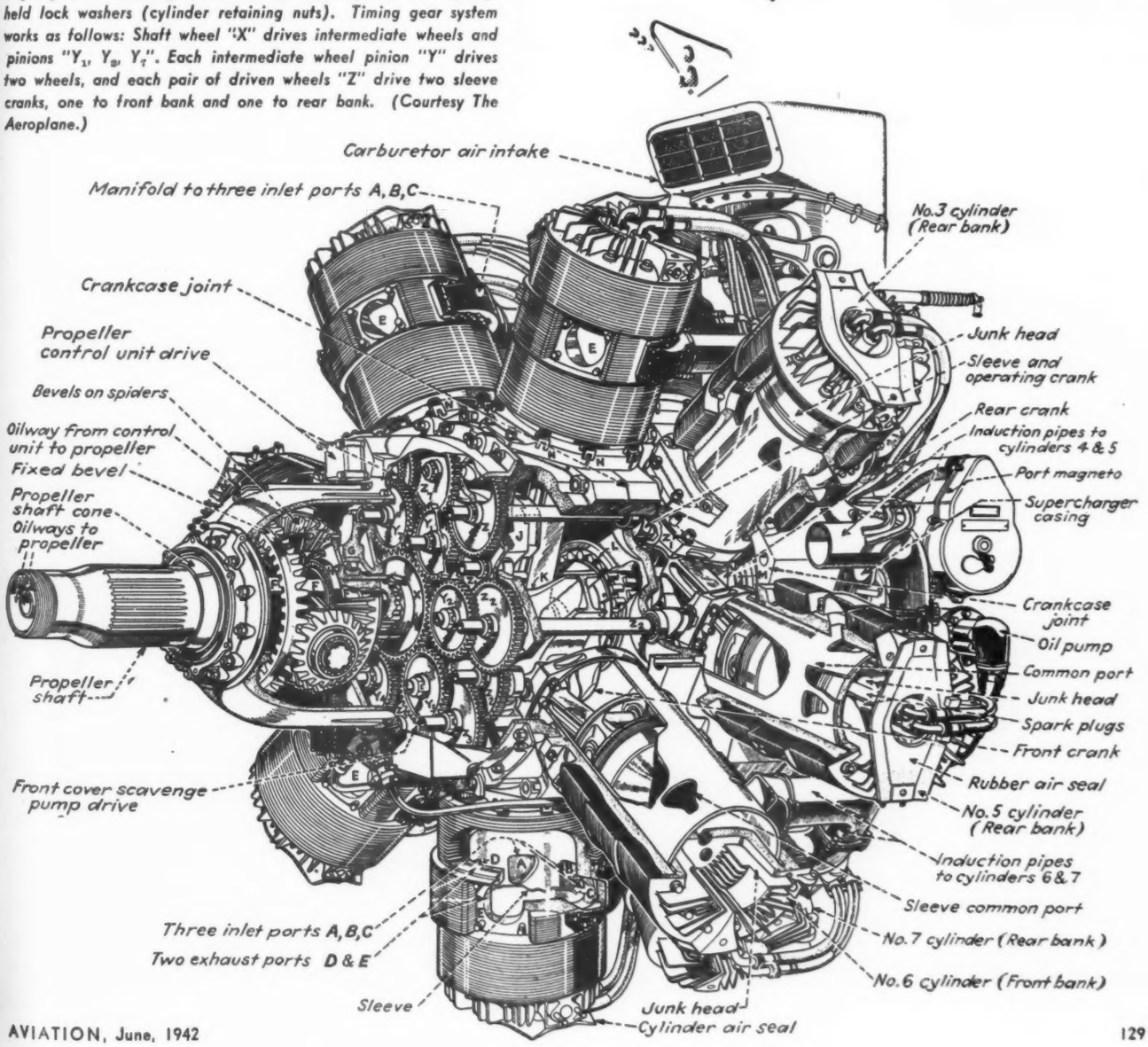
AEROQUIP SELF-SEALING COUPLINGS



The gunner's enclosure structure on the Messerschmitt Me 110, at left and below, is of welded steel tube and consists of three main parts: a tiltable hood at the aft end, jettisonable fixed section forward of the hood, and a sliding top section for the hood. Rear section is hinged to tilt up while the top section lifts slightly from its fixed side panels and slides forward in a guide at the center of the fixed portion of the enclosure. These three units are linked together and balanced with a bungee cord to permit opening and closing as a single operation. The entire enclosure is held in place by four pins and can be jettisoned by releasing the pins by movement of a handle near the flexible gun. (Courtesy Vultee Aircraft, Inc.)



The 14-cylinder, 2-row Bristol Hercules radial engine, rated at 1600 hp., is used on the Short Stirling heavy bomber, and is shown in the cutaway view below. The Hercules, now said to be in large scale production, was first tested in 1936 and closely follows the Perseus in its general features. Inlet ports are shown at "A" and "B", while exhaust ports are at "D" and "E". The spider shaft, which is one piece with the propeller drive shaft, is at "F" and "G" is the roller bearing (reduction gear driving wheel); "H" ball bearing (reduction gear thrust); "J" crankshaft balance weight; "K" master rod (No. 4 cylinder front bank); "L" crankshaft self-aligning center bearing; crankshaft rear bearing, and "N" spring-held lock washers (cylinder retaining nuts). Timing gear system works as follows: Shaft wheel "X" drives intermediate wheels and pinions "Y_1, Y_2, Y_3". Each intermediate wheel pinion "Y" drives two wheels, and each pair of driven wheels "Z" drive two sleeve cranks, one to front bank and one to rear bank. (Courtesy The Aeroplane.)



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Designed, built and tested for aircraft use, Wittek Type FB Stainless Steel Hose Clamps are used by leading aircraft manufacturers, engine builders and commercial airlines as the standard Hose Clamp of the industry.

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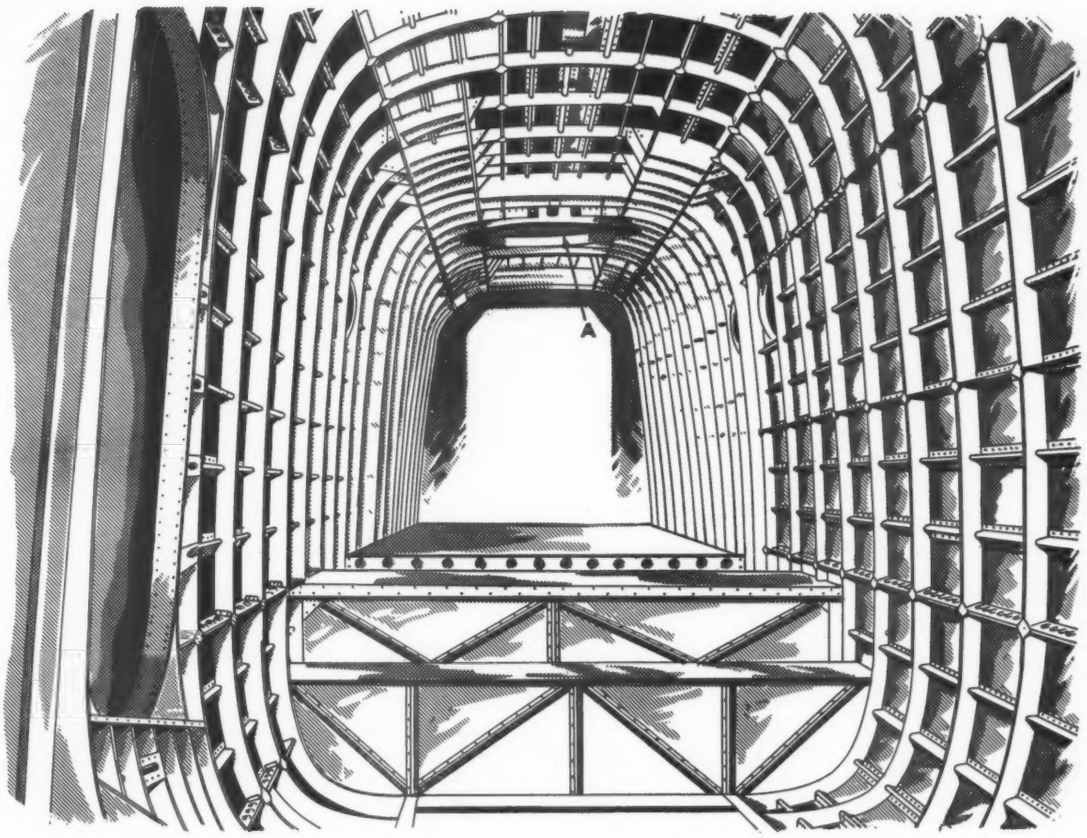
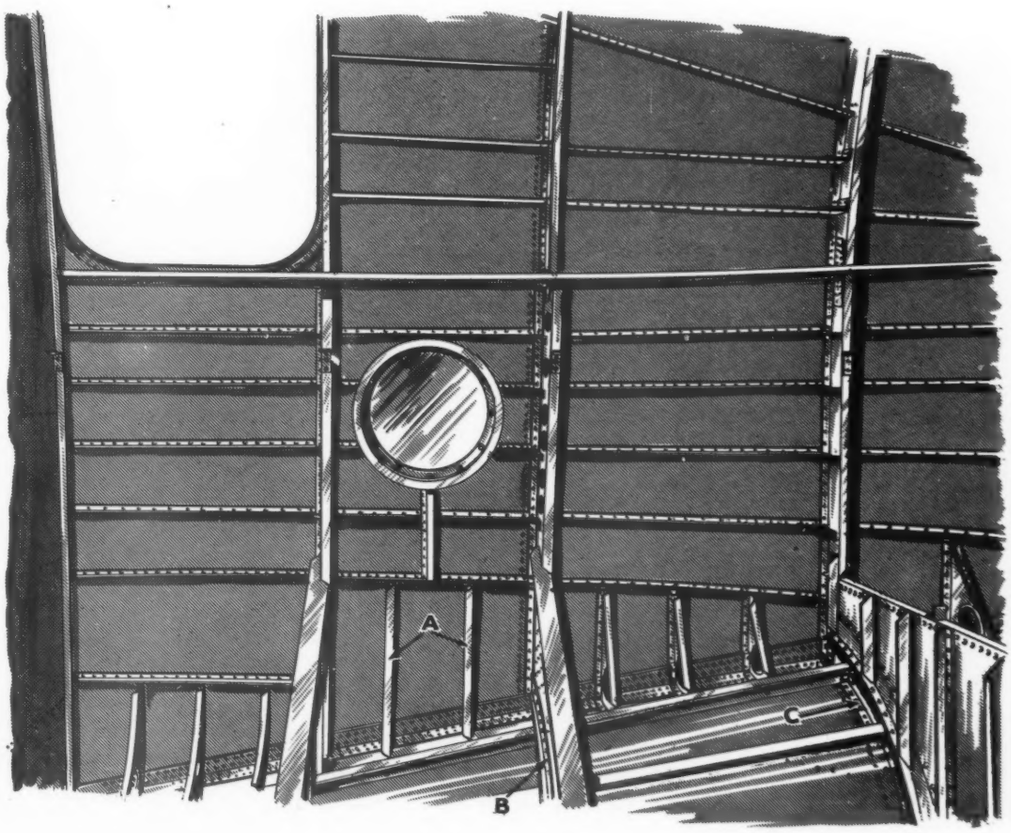
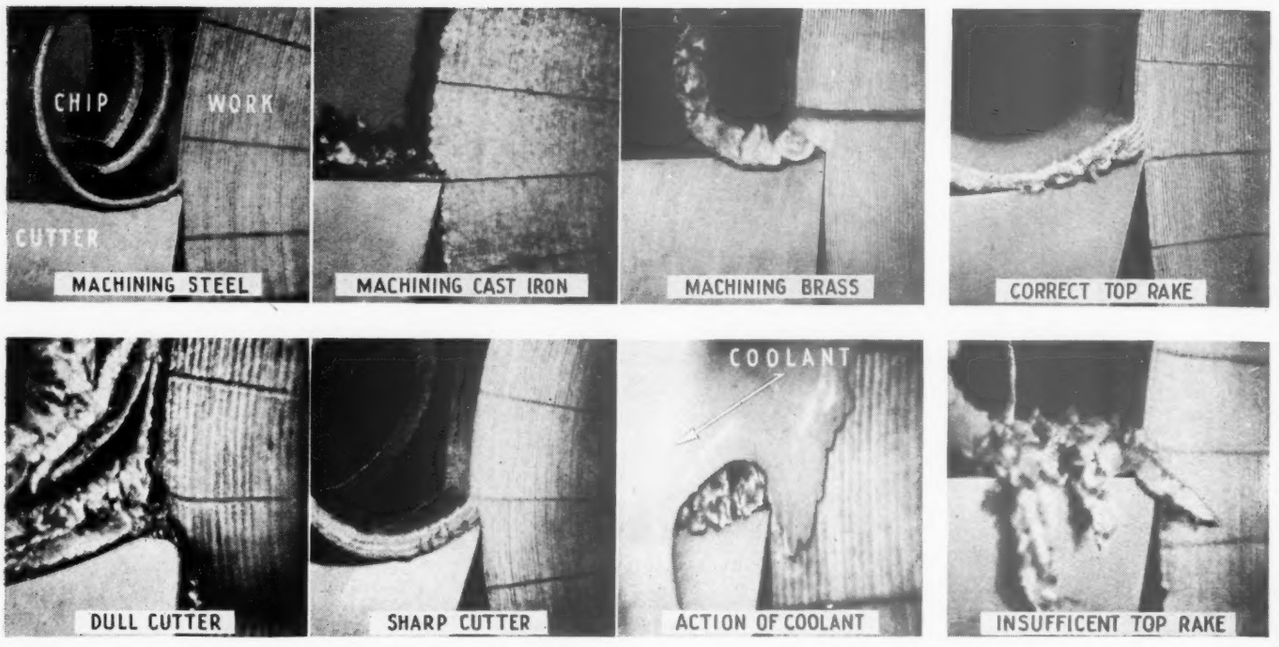


This interior view, above, of the Short Stirling fuselage construction is of the section just aft of the trailing edge of the wings. The power-operated dorsal gun turret is installed at "A" and the steps in the foreground mark the after end of the bomb cells underneath which measure 42 ft. 7 in. in length. At this end of the bomb bay the chutes for the parachute flares are installed.



The port side of the bow compartment of the Vought-Sikorsky VS-44-A is shown at right. Notice the sections at "A" which are attached to both the side and bottom of the hull to take the concentration of load which occurs at the corner. Notice, also, how the longerons at "B" lie between the bulkhead and the outer skin, while at "C" the bulkhead is brought out flush with the skin.



Slow-motion close-ups showing the operation of metal-turning cutters from the moving picture Chips, a feature of Warner & Swasey Company's new training program on the grinding and setting of cutting tools. The distance between the marks on the work piece is approximately 1/8 in. The correct grinding and setting of tools conserves tools and speeds production.

Film on Tool Grinding and Cutting

A most instructive sound movie and talk on the proper method of grinding cutting tools and the effect which grinding and tool setting have on the cutting of metals have been announced recently by Warner & Swasey Company, well known makers of turret lathes. It is planned that the film and talk will be given at plants engaged in war work before operators and trainees between shifts or at other hours convenient to all concerned.

This is to be done by appointment with the company's Turret Lathe Operators Service Bureau and without charge. Models of tools and charts are used in combination with the film and opportunities for questions are afforded.

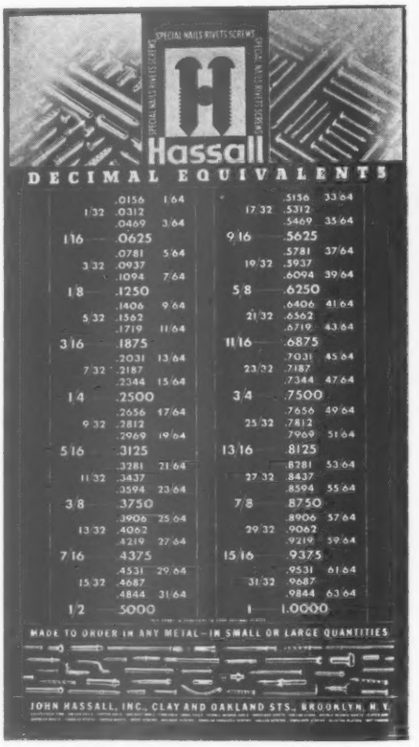
Operators who attend the program receive a 16-page illustrated booklet containing the high spots and fundamentals of instruction and showing what happens when tools are properly ground and when grinding is not properly done or is delayed too long.

Normally the program requires about one hour. Although dealing specifically with the types of tools used on turret lathes, the fundamentals shown and discussed apply equally well to other lathes and to some other tools used for metal cutting. The whole program is highly instructive and of a type which operators understand and appreciate.

Hydraulic Test Regulator

Apparatus capable of testing all hydraulic parts of an airplane simultaneously has been put into practical use at the Grumman aircraft plant. The machine performs its task by simulating speed and flight conditions, and contrasts to earlier equipment which had to be applied to one part at a time. As seen in the photo, it is a laboratory on wheels with meters to show the reactions of a plane under artificial conditions.

The particular apparatus shown was made by Henry Sieck, foreman of the Plant 2 hydraulic department, from a previous Grumman development. A further accomplishment of the machine is its ability to pime the whole hydraulic system and reservoir with oil within a few minutes. The task formerly had to be done by funneling the oil into the hydraulic system.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DECIMAL EQUIVALENTS
MADE TO ORDER IN ANY METAL—IN SMALL OR LARGE QUANTITIES
JOHN HASSALL, INC., CLAY AND OAKLAND STS., BROOKLYN, N.Y.

DECIMAL EQUIVALENTS

For the convenience of technical men, John Hassall, Inc. of Brooklyn, N. Y., manufacturers of special nails, rivets and screws, essential to the war effort, have just issued the above chart of decimal equivalents. The chart is printed in three colors signaling the fractional denominations. The chart may be obtained free by writing to John Hassall, Inc., Clay and Oakland Sts., Brooklyn, N. Y.

The B.F. Goodrich Airplane of the month

CURTISS WAR HAWK

FROM THE ROAD TO MANDALAY to the frigid tundras of Russia, the Curtiss P-40 type fighter has turned in a record performance for the United Nations. And it is only natural that this bullet-swift pursuit bears the Curtiss name. For, since the days of the "pusher," Curtiss-Wright has been a leader in aviation.

Other members of the Curtiss family now winning their service stripes for Democracy include the Navy's "Hell Diver" dive bomber and the huge C-46 transport. B. F. Goodrich salutes Curtiss and nominates the War Hawk, newest Curtiss pursuit, as "Plane of the Month."

The Army flies with

B.F.Goodrich

FIRST IN RUBBER

B.F. GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*

AMERIPOL

. . . our synthetic rubber that is serving America now!

UNCLE SAM'S challenge is to "Keep 'em Flying." And that means dozens of rubber or synthetic rubber parts *must* be available. B. F. Goodrich is pleased to report on the contribution our own butadiene synthetic rubber, known as Ameripol, has already made, to help the Industry meet that challenge.

For many products, Ameripol has proved far superior to natural rubber for aeronautical accessories. Ameripol's resistance to gasoline and oil, for example, has made it ideal for airplane hose, hydraulic seals, and other accessories where natural rubber tends to rot and disintegrate.

The following chart, which illustrates the relative properties of Ameripol and natural rubber, immediately makes plain the advantages of switching to Ameripol, first in aviation synthetics, for many items:

Properties	Synthetic Ameripol	Natural Rubber	Properties	Synthetic Ameripol	Natural Rubber
Resistance to:			*Range of:*		
Abrasion	★		Elasticity		★★
Acids and Alkalies	★		Elongation	★	
Aging	★★		Hardness	★	
Heat	★★		Permanent Set	★	
Oil, Grease & Petroleum Solvents	★★		Tensile Strength	★	
Oxidation	★★		*Reaction to:*		
Tear		★★	Sub-Freezing Temperatures		★★

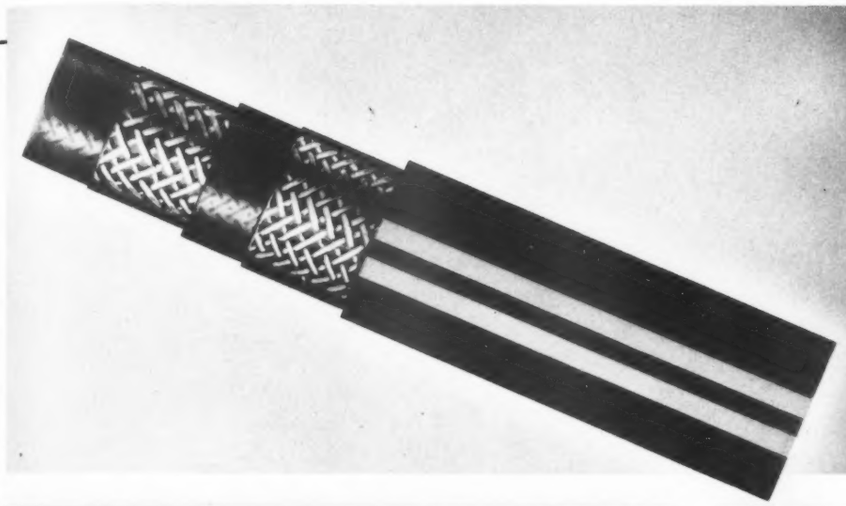
Code: ★ Equals ★★ Excels

Ameripol, a product of 16 years' research in B. F. Goodrich laboratories, was first announced publicly in June, 1940, as a practical substitute for natural rubber in tires. On the right-hand page are some of the products made with Ameripol that are now *in the air!* We are proud of this contribution and we pledge our continued efforts to "Keep 'em Flying" with natural and synthetic rubber parts. Write for descriptive literature. B. F. Goodrich, General Offices, Akron, O.

MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

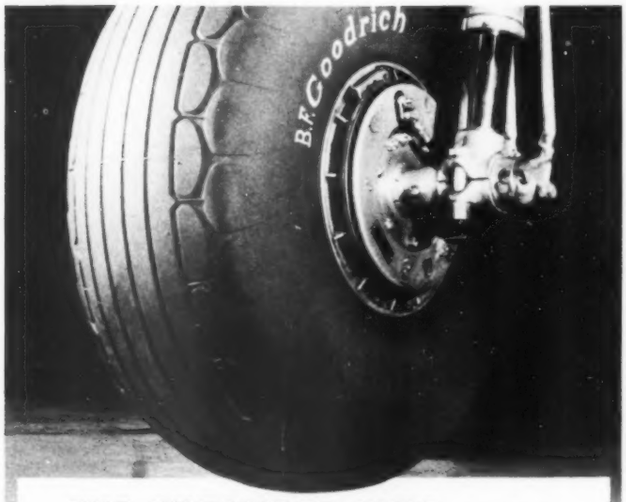
Ameripol

SERVES WITH THE AIR FORCE



GASOLINE AND OIL HOSE. Airplane hose serves in a number of important products on United States fighting planes. Proved by performance, Ameripol synthetic rubber was used for B. F. Goodrich fuel and oil hose many months before the war emergency brought synthetics to their present prominence.

GROMMETS ★ HYDRAULIC SEALS ★ GASKETS. Perhaps they look trivial. But they're vital to a plane's performance. Made with Ameripol, they offer: low oil absorption (swell does not exceed 6%)—high resistance to wear, heat and sub-zero temperatures—will not corrode metals—can be accurately molded to desired precision tolerances.

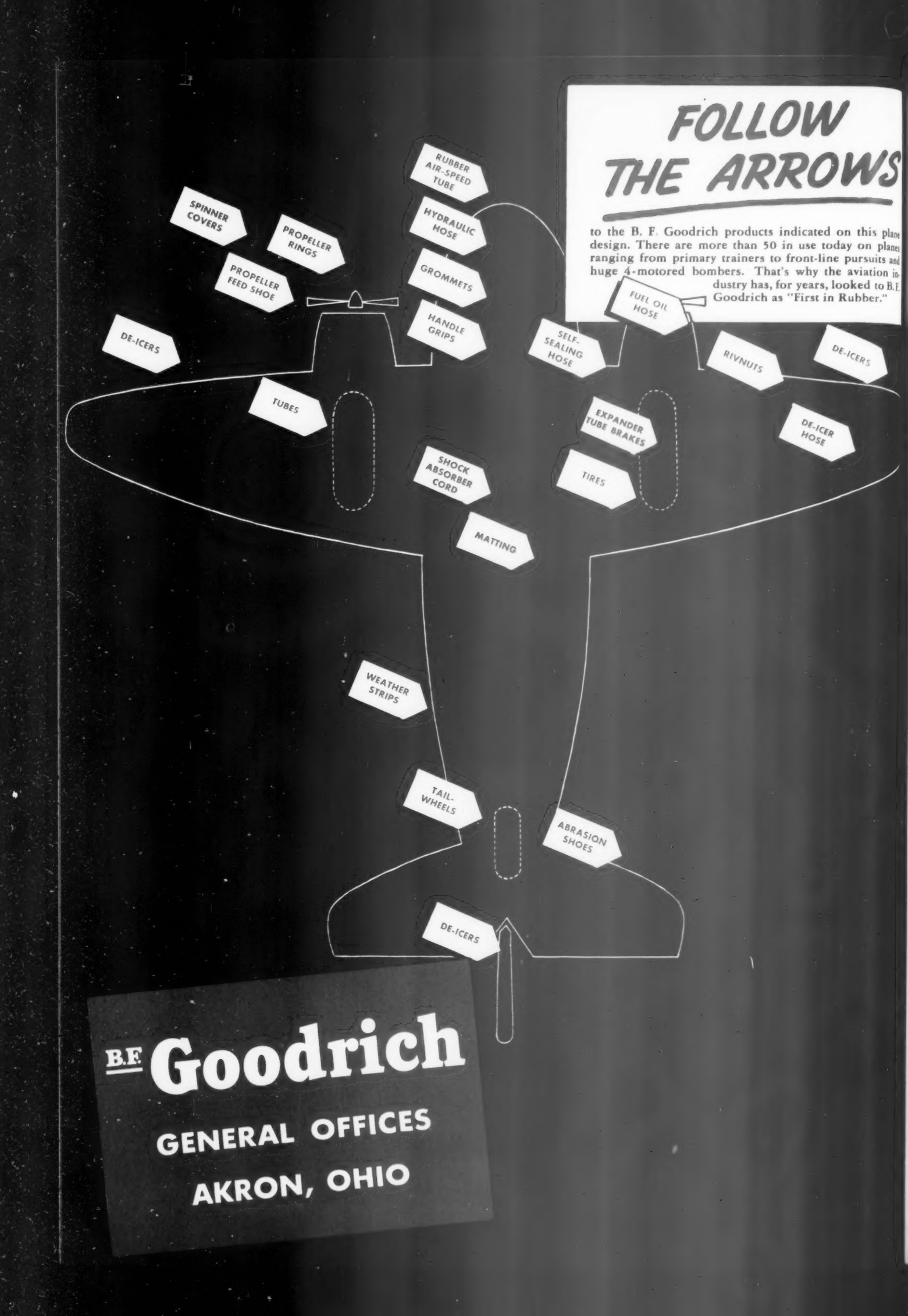


THE EXPANDER TUBE of a B. F. Goodrich E. T. Brake is also made of Ameripol. When this tube is inflated with braking fluid, it expands, forcing the brake lining blocks into uniform contact with the revolving brake drum attached to the plane wheels, and the plane comes to a smooth, safe stop.

In war or peace

B.F. Goodrich

FIRST IN RUBBER


FOLLOW THE ARROWS
to the B. F. Goodrich products indicated on this plane design. There are more than 50 in use today on planes ranging from primary trainers to front-line pursuits and huge 4-motored bombers. That's why the aviation industry has, for years, looked to B.F. Goodrich as "First in Rubber."
RUBBER AIR-SPEED TUBE
HYDRAULIC HOSE
GROMMETS
HANDLE GRIPS
SPINNER COVERS
PROPELLER RINGS
PROPELLER FEED SHOE
DE-ICERS
TUBES
SHOCK ABSORBER CORD
MATTING
FUEL OIL HOSE
SELF-SEALING HOSE
RIVNUTS
DE-ICERS
EXPANDER TUBE BRAKES
TIRES
DE-ICER HOSE
WEATHER STRIPS
TAIL-WHEELS
ABRASION SHOES
DE-ICERS
B.F. Goodrich
GENERAL OFFICES
AKRON, OHIO

MODERN MACHINE TOOLS

New Products

Libby No. 4 Universal Ram Type Turret Lathe

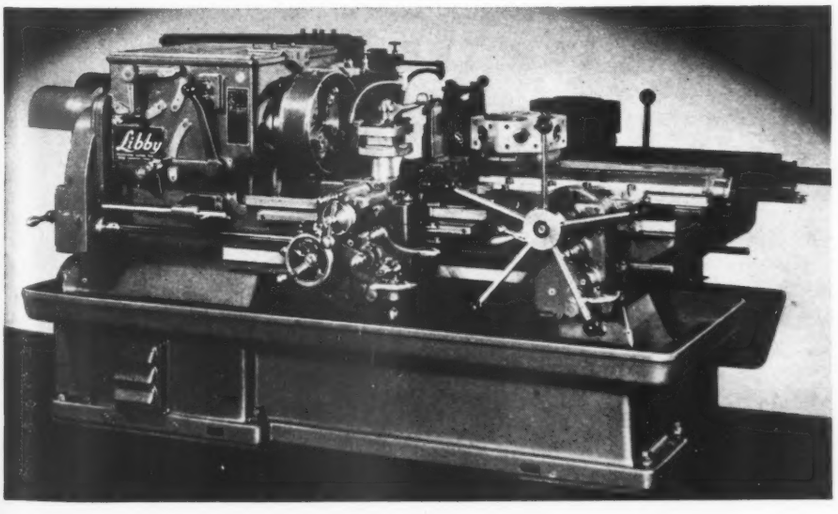
A new International Libby No. 4 Universal Ram Type Turret Lathe with collet chuck capacity 2 in. dia., 22 in. turning length, and having 20 in. swing over ways, is announced by the **International Machine Tool Corp., Libby Div.**, Indianapolis, Ind. The machine is supplied complete with tools for both bar work and chucking work, and will accommodate 8 in., 10 in., and 12 in. dia. chucks. In addition, the machine may be equipped with special attachments which conform to specific applications or specific types of turret lathe work. These attachments include bar feed and collet chuck, taper attachment, and threading attachment. The one piece bed and headstock is cast from nickel semi-steel and the machine is extra wide across the bed ways, measuring 12½ in. which is approximately 43 percent wider than is usually found on machines of this capacity. The heavy bed has internal cross ribs and longitudinal ribs that run the entire length to provide reinforcement that rigidly supports the carriages and permits accurate heavy cuts.

Spindle control is provided by a single lever which operates a double multiple disk main drive clutch. In the forward position of this lever the spindle rotates forward, and in the backward position, the spindle reverses direction of rotation. When this lever is in a neutral position, a sturdy multiple disk brake is applied automatically to stop the spindle quickly and save valuable operating time. The all-geared headstock provides twelve spindle speeds which are controlled by three levers mounted on the front of the headstock in a convenient position for the operator. Individual motor drive is provided for the machine, and power is transmitted by silent-operated multiple "V" belts. Motor is mounted in the base of the machine on a hinged base which provides a means for tightening the bolts. Motors of 5 and 7½ hp. are regularly furnished depending upon the work. These motors run at 1000 and 1,200 rpm. respectively to give standard spindle speeds.

The universal carriage is provided with six reversible cross and longitudinal feeds which operate independent of the hexagon turret carriage. Feeds are engaged by individual levers which operate large diameter friction type clutches, which may be adjusted from the outside of the apron. Quick acting levers disengage the feed by a slight touch of the hand, or may be set for automatically disengaging the power feed at predetermined points.

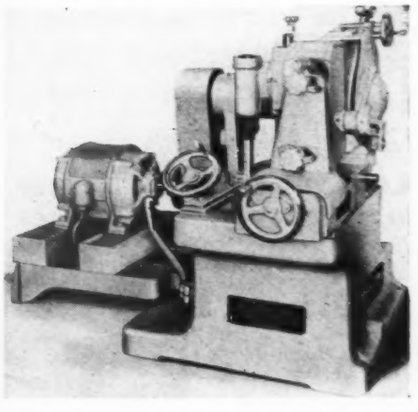
The cross slide holds the quick indexing square turret at the front and is provided with three cross "T" slots at the rear for holding the rear tool post. The rear tool post is used for cutoff and forming operations, and may be positioned in any one of the three "T" slots for different work diameters. The quick indexing square turret tool post is operated by only light pressure on a single handle which is used to unclamp and reclamp the turret in a newly indexed position.

The hexagon turret ram slide carriage is provided with six power feeds to the ram slide in the forward direction. Feeds are engaged by a quick acting lever on the turret apron which may be disengaged by a touch of the hand. Automatic feed trip and dead stop is provided for each face of the hexagon turret by means of a six screw stop roll. These screws are adjustable by a crank and may be individually set for a series of operations. The hexagon turret is automatically unclamped, indexed and reclamped by means of the five spoke pilot wheel which controls the forward and reverse movement of the ram slide. When the ram slide is moved back, the turret is automatically unclamped and indexed to the next position. On the forward motion the turret is automatically located by a hardened and ground taper locating plug in a hardened and ground steel bushing in the hexagon turret. Simultaneously on the forward motion of the ram slide, the hexagon turret is automatically clamped in place by a double tapered locking ring operated by a powerful toggle lever arrangement, and no strain of the cut is exerted on the locating pin which serves only to accurately locate the hexagon turret. —AVIATION, *June*, 1942.



Production Polisher

An automatic centerless feed polishing machine used in finishing airplane struts by inexperienced labor, giving any grade of finish at the fastest feeds and lowest costs, is offered by **Production Machine Co.**, Greenfield, Mass. The No. 101 is a sturdy, substantial machine using for the polishing member the



MOLYBDENUM ENLISTS FOR THE DURATION

The enormous increase in requirements of molybdenum has necessitated the War Production Board Order M-110, placing molybdenum consumption under allocation control...Our metallurgical research staff is fully engaged in war work. At our mine, mill and converting plant, every effort is being made towards maximum production.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS. MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

various types of wheels that may be required to produce the work. Wheel mounting is unusually heavy, the large shaft running in heavy, self-aligning ball bearings and driven by a triple V-belt drive. A swinging frame provides quick adjustment for wheels varying in diameter from 10 to 16 in. A suitable trueing service is provided for trueing the wheels while in motion. The wheel may also be adjusted to and from the work while running, permitting fine, accurate adjustments. Centerless feed is mounted in a tilting housing which provides for varying the speed feeds as desired. Height of machine overall is 45 in.; height of center above floor, 33 in.; wheel spindle, 1¾ in. dia.; flanges, 6 in.; wheels, 10 in. dia. by 4 in. face. Horsepower required 7½ to 10, furnished either belt-driven or direct motor connected. — AVIATION, *June*, 1942.

Duro Punch Press

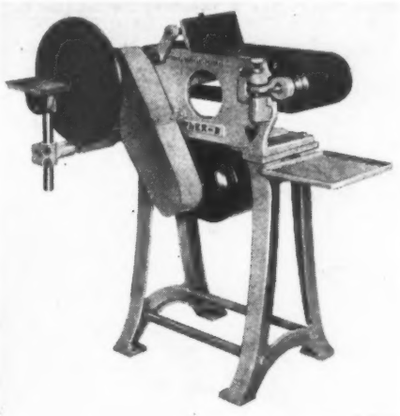
Equipped with bronze bearings at all wear points to assure long life at top production speeds, a new line of punch presses is now being offered by the **Duro Mfg. Co.**, 800 E. 61st St., Los Angeles, Calif. Available in one-ton and four-ton models the Duro Punch Presses have many features not found in any but the heaviest presses. Said to be an exclusive feature, is the heat

treated alloy steel driving shaft which is absolutely straight, and same size throughout, without eccentric, eliminating danger of shearing or twisting. Directional change of punch force is transmitted by a unique eccentric press fit onto the driving shaft and held securely by keys. Eccentric operates in heavy bronze bearing. The ram or punch of the Duro presses rides in semi-steel guides, slotted for lubricant distribution and adjustable for wear. Specifications:

(4-ton)—weight, 185 lb.; width, 12 in.; height, 25 in.; depth, 15 in.; accommodates dies up to 4¾ in.; stroke standard, 1 in. (1-ton)—weight, 60 lb.; width, 8 in.; height, 17 in.; depth, 10 in.; accommodates dies up to 3¾ in.; stroke standard, ¾ in.—AVIATION, *June*, 1942.

Duplex Grinder

An abrasive band and disk grinder, the Duplex B-M model, for which **Walls Sales Corp.**, 95 Warren St., New York, N. Y., are sole sales representative, is available for use in aircraft and accessory plants. The



Duplex B-M Grinder is really a power driven Duplex B model. Machine is equipped with a 1 hp. heavy duty motor mounted underneath frame casting. A fully enclosed dual V-belt drive is used, and a simple, practical screw adjustment for taking up slack in the V-belt is provided. The band grinding table is 10x18 in. and the disk grinding table 4½x7 in. The abrasive band is 8x61 in., while the disk is 15 in. in dia. Speed is 1,300 rpm.—AVIATION, *June*, 1942.

New Dial Feed Press

Timely to the accelerated armament program is the announcement of the new Federal Multiple Dial Feed Press, by the **Federal Press Co.**, Elkhart, Ind. Positive indexing and locking mechanism of the dial feed permits unusually high speed with accuracy and safety. All moving parts are enclosed, except the dial plate itself, removing the possibility of injury to the operator.

CRESCENT
is an important source of supply for
AVIATION CABLE

Crescent manufactures a complete line of electric wire and cable for every aircraft need—starter cable, high-tension cable, primary cable—original or replacement. Crescent also manufactures welding cable.

And every Crescent Aviation Cable is a quality cable—made of prime materials, processed under the Dostam Method of manufacture for high efficiency, long life, dependability and uniformity.

We will promptly answer your inquiries concerning wire or cable for any type of service.

THE CRESCENT COMPANY
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Largest independent maker of replacement wiring for the automotive industry

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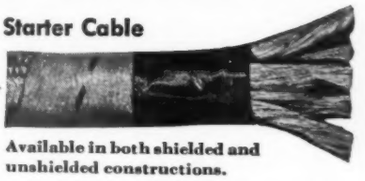

Available in both shielded and unshielded constructions.

P.S.
OF COURSE, CRESCENT WIRE AND CABLE FOR THE AIRCRAFT INDUSTRY MEETS ALL ARMY AND NAVY SPECIFICATIONS . . .
Wirey Joe

SAFEGUARDING

The Spark That Means Speed

PACKARD AIRCRAFT CABLE

In military and commercial aircraft, Packard aircraft cable is performing its function dependably under severe conditions of operation. Packard cable is designed to meet exacting requirements . . . manufactured to insure uniformity.

"Working for Victory"

Packard

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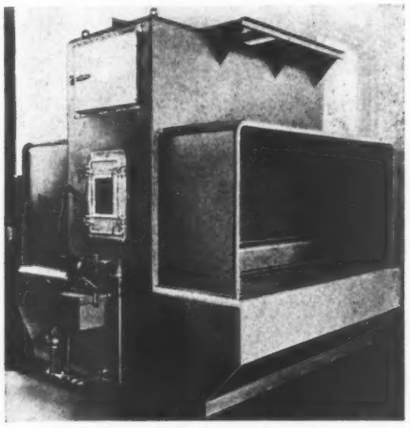
PACKARD ELECTRIC DIVISION
General Motors Corporation, Warren, Ohio

New Products

Indexing is obtained positively and accurately by a cam and gear arrangement in connection with the crankshaft. This specially developed cam smooths out indexing motion to facilitate speed. Cam allows the dial to be indexed in any part of the revolution of the crankshaft from 90 deg. to 180 deg. Thus, there can be obtained a long or short dwell of dial, allowing operator whatever time is necessary to inject work into the fixture in the dial station. Unit can be adapted to handle a tremendous variety of secondary operations. The simple design and positive action of the dial feed permits a wide range of tooling for hundreds of jobs. Dial feeds are available on eight sizes of Federal presses, from 6 to 80 ton capacities. Dial plates on the Nos. 0, 1, and 2 Federal presses have 10 stations—on Nos. 3, 4, 5, 6, and 7, the dial plates have 12 stations. Features of the precision construction are: the press is checked from 6 points to a tolerance of .0015; ram is bored in exact alignment with extra long V-ways; new safety lock feature makes it possible to set or adjust dies while the flywheel is in operation; incline adjustment operated from the front of the press makes for ease and safety; flywheel bearings are Timken equipped, bearing caps are split vertically, resting on reinforced frame, thus transmitting shock from the thrust and return strokes directly to the frame. Crankshaft bearings are handscraped to assure accuracy.—AVIATION, *June*, 1942.

Mahon Hydro-Foam Dust Collector

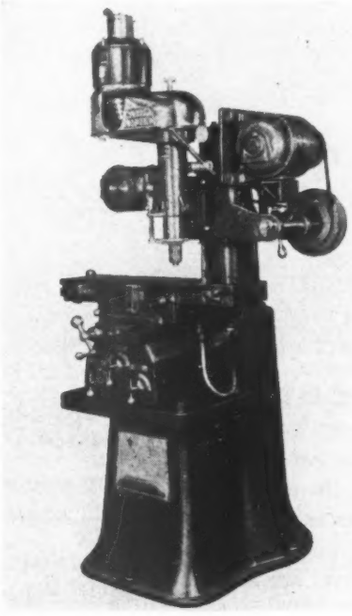
In burring and grinding operations on magnesium alloys, the danger from fire is an ever present menace unless suitable precautions are taken for its prevention. Dust and chips from magnesium alloys are highly inflammable and should be wetted as quickly as possible after being formed. The Mahon



Hydro-Foam Dust Collector, made by **R. C. Mahon Co.**, Detroit, Mich., was developed to collect, under water, various dusts formed by industrial processes and is ideally adapted to the collection of dust and chips formed in the burring and grinding of magnesium alloy castings. It is a completely self contained unit, providing in one machine both bench and hood, together with adequate dust collection and ventilation. The tank, forming the base of the unit, is filled with water, kept at a constant level, and supplied with water service to make up the small evaporation losses. The side extension of this tank forms the bench which has for its surface a wooden grillage. The hood formed above the grillage confines the operations and the dust therefrom is drawn through this grillage onto the surface of the water, directly underneath. The larger chips and coarser dust particles settle by gravity to bottom of the tank. The air, still carrying a considerable volume of dust, is then forced downward at high velocity against the water solution in the tank, forcing the bulk of remaining dust into the water. The impinging action of this operation aerates the water solution and creates a bed of spray in the chamber above the water tank. Only the finest dust particles remain in the air currents passing up and through this spray, where they are wetted and retained in this third and final stage of dust removal. Only moving part is the motor driven fan. One starter only is needed. Unit is portable.—AVIATION, *June*, 1942.

Universal Turret Miller

Claimed to have a range and flexibility never before achieved in a single machine, a new Universal Turret Milling Machine carrying the trade name of Armor has been announced by the **Aircraft Machinery Corp.**, Burbank, Calif. This milling machine, with hydraulic feed, utilizes a combination of a horizontal spindle and a vertical spindle capable of any angle, mounted on a single rigid turret, rotating a full 360 deg. thus opening up an entirely new field of uses in the tool room, pattern shop, experimental laboratory and general production plants. For production milling, the hydraulic feed on longitudinal table is said to provide smooth power for deep cuts while hydraulic valves provide metered feed and rapid transverse in either direction. Micrometer stops guard against overrun, and hydraulic relief protects cutters against



breaking or undue strain, making the Armor Turret Miller particularly adaptable to inexperienced operators. For tool room and experimental purposes, two simple levers rapidly and easily convert longitudinal travel from hydraulic feed to hand feed without disturbing work. The return to hydraulic feed is equally simple. Other features include: vertical, angle and horizontal spindles with three low and three high spindle speeds.—AVIATION, *June*, 1942.

PENCO
"3-Shift"
Steel Tool Stand
Welded for
STRENGTH!
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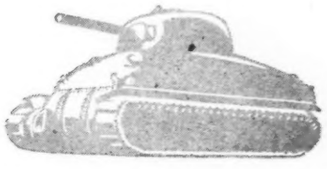
Designed for
24-HOUR SERVICE



Like Uncle Sam's latest type M-4 tank, the PENCO "3-Shift" Tool Stand is *welded* to withstand tough punishment.

Each of the three drawers locks separately — a single drawer for each shift. *Saves time, temper* and *tool losses.* Keeps 'em on the job 24 hours a day.

War industries, prime and subcontractors — write for details and prices.

1869 Penco

Penn Metal Corporation of Penna.
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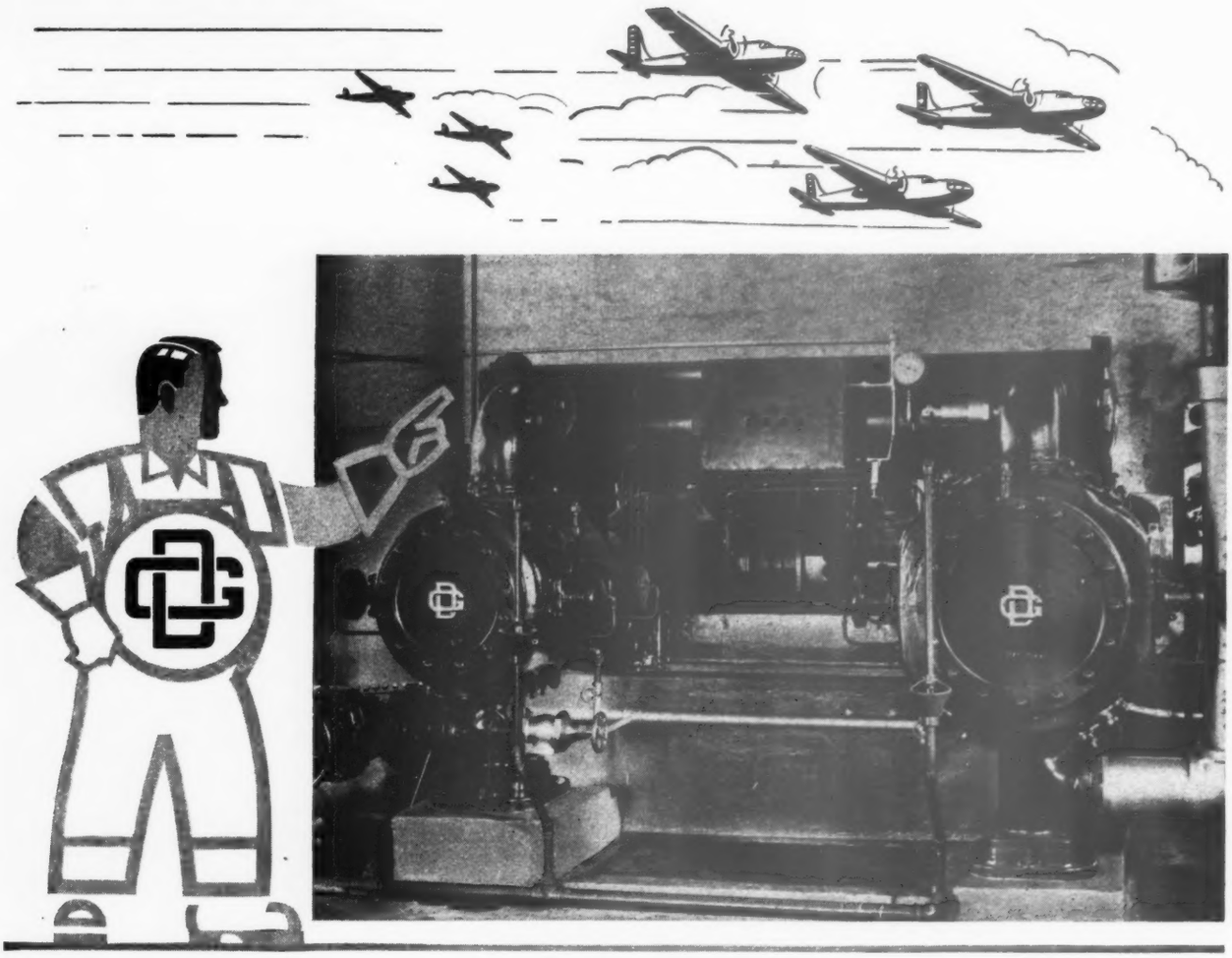

HERE'S MORE *Airpower* ...
TO SPEED THEM ON THEIR WAY

POWER—plenty of it—that's what it takes to carry on today's gigantic production schedules. And plenty of airpower is what you get when you install husky Gardner-Denver "HA" Two-Stage Horizontal Air Compressors. Yet, there is no *waste* of power, for the greater air capacity of "HA" compressors is under constant, automatic control—and the air supply is constantly regulated to fit your air needs. Operating costs are low because these compressors are designed for unusually low horsepower requirements. Maintenance costs are nominal —as user experience in many a plant has shown.

"HA" ADVANTAGES

1. Long years of service assured by rugged, dirt-free construction.
2. Extra efficiency due to liberal and unrestricted valve and port areas.
3. "Air-cushioned" Duo-Plate Valves actually become tighter with use.
4. Built in sizes ranging from 316 to 2012 cu. ft. displacement per minute.

For the complete specifications on Gardner-Denver "HA" Horizontal Two-Stage Air Compressors, write Gardner-Denver Company, Quincy, Illinois

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TASK FORCES *BEHIND* TASK FORCES

Somewhere, tonight, the Navy has a task force in action.

In thousands of plants, tonight, Industry has task forces in action too.

This one, operating at VARD, is engaged with America's greatest adversary—*time*. Like the Navy forces, it is alert, determined—and moves with precision. It knows it is in a war.

Other task forces at VARD—in research and in production—are also working against time; also in the war.

Their task is to design, build, and deliver on schedule the many precision-made VARD products used on Navy ships, Navy planes, and in hundreds of plants from coast to coast making Navy parts and equipment.

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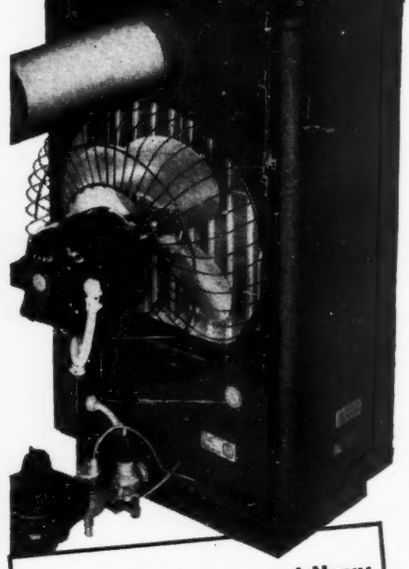

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From a suspended position, Reznor unit heaters distribute clean, uniform, automatic heat over wide areas. Installations and deliveries save days and often weeks. Reznor gas heating REQUIRES 89% LESS VITAL MATERIALS than any other type of system. . . Write today for data on a complete range of sizes.

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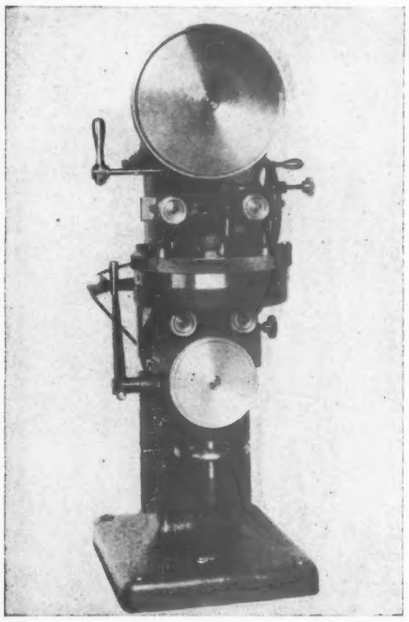
"GAS HEATERS EXCLUSIVELY SINCE 1888"

Heim Die Polisher

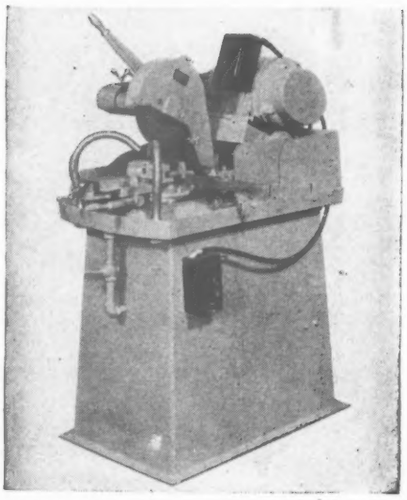
Now in extensive use for production grinding of ball races on aircraft bearings, the Heim Die Polishing Machine, made by **The Heim Co.**, Fairfield, Conn., is completely motorized. This machine is said to be the pioneer in the method of polishing drawing dies by the use of an



endless abrasive belt driven at grinding wheel speed, which polishes the die substantially parallel with the line of draw of the work through the die. This method of polishing is also said to impart a finish to the die never before attained, resulting in a much finer finish to the work, as well as materially reducing upkeep and increasing life of dies. Almost any style of die can be polished on this machine, such as dies used in drawing rods, bars, tubing and deep drawing dies. Some other shapes can also be polished by use of special fixture which can be furnished as an accessory.—AVIATION, *June*, 1942.

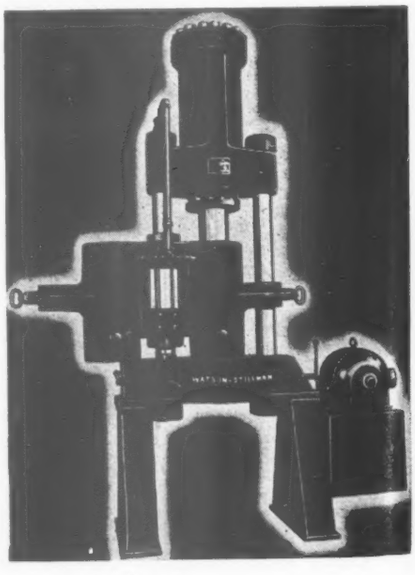
Radiac Abrasive Machine

For accurately cutting off bars, tubing and formed shapes, **A. P. de Sanno & Son, Inc.**, Phoenixville, Pa., offers the Radiac Type N Abrasive Wet Cut-Off Machine. The cut is clean and smooth, and seldom requires any additional finishing. The coolant, which is directed onto the wheel and work at the point of cutting, increases wheel life, reduces cutting heat and minimizes any tendency to burn. Sturdy construction of every part of the machine, precision machining, and proper balancing of all moving parts are said to eliminate vibration which is the cause of excessive wheel wear, and result in economical operation. Two types of vises may be supplied. A straight vise for straight cuts only, or a swivel vise for straight or angle cuts up to 450 deg. There are three outstanding special features of this machine: the patented hand operated vise; new non-tiring handle; and stubs of larger abrasive disks from larger Radiac or other cut-off machines. —AVIATION, *June*, 1942.



Watson-Stillman Press

A 200-ton-capacity hydraulic straining press, manufactured by **The Watson-Stillman Co.**, Roselle, N. J., strains or filters fluids under a pressure of 2,000 lb. psi. The machine has two cylindrical containers, each 10 in. in dia. and 33 in. deep, mounted on a swinging arm so that one may be filled while the press strains material from the other. The press is completely self-contained, including 20 hp. motor, 18 gpm. pump, and oil tank. The entire unit stands 14 ft. high, weighs 15,000 lb. and requires 5 ft. x 3 ft. of floor

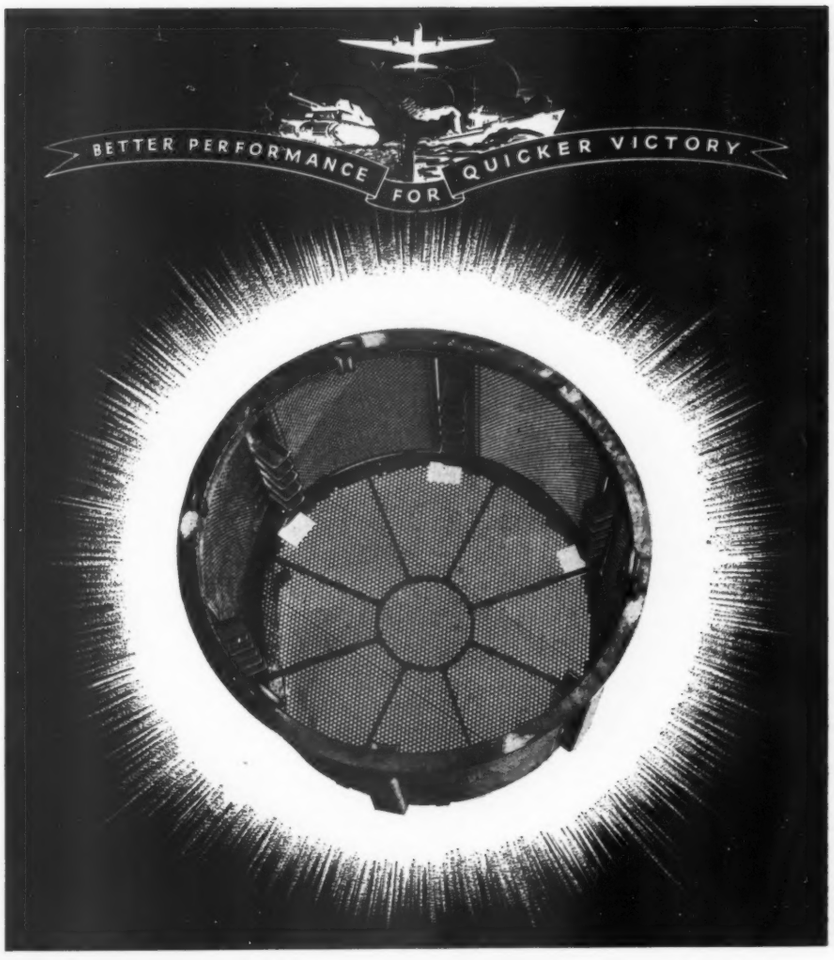


space. Control is by a single, lever-operated valve. The main ram has a 33 in. stroke and operates in a double-acting cylinder. Two container lifting cylinders facilitate swinging of the containers between loading and straining operations.—AVIATION, *June,* 1942.

Hammond "600" Dri-N-Wet

A new "600" Dri-N-Wet abrasive belt surfacer has just been placed on the market by **Hammond Machinery Builders, Inc.,** 1638 Douglas Ave., Kalamazoo, Mich. Machine can be adjusted from vertical to horizontal position while running. The belt tension and tracking device can likewise be adjusted while running, and is quickly accomplished by two conveniently located

handles. Machine is totally enclosed for safety and the "600" Dri machine is arranged for an individual dust collector, or for connection to an exhaust system. The abrasive belt pulleys are made of cast iron and are dynamically balanced. Work table can be adjusted to any desired working angle and is available for bench or floor model. The Dri-N-Wet machine (floor model illustrated) is equipped with tank and pump unit and can also be equipped for water main connection only. Should dry operation be desired, merely turn off water, remove drain connection, and attach air exhaust system at this point. Vacuum cup drive pulleys eliminating belt slippage furnished on wet machines only.—AVIATION, *June,* 1942.



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Above is a special Annealing and Heat-Treating Basket made to specifications for a large aircraft manufacturer. Enlarged plant facilities made possible the delivery of all types of Carburizing and Annealing equipment promptly. We are prepared to handle your requirements now. Here you will find quality production on a quantity basis.

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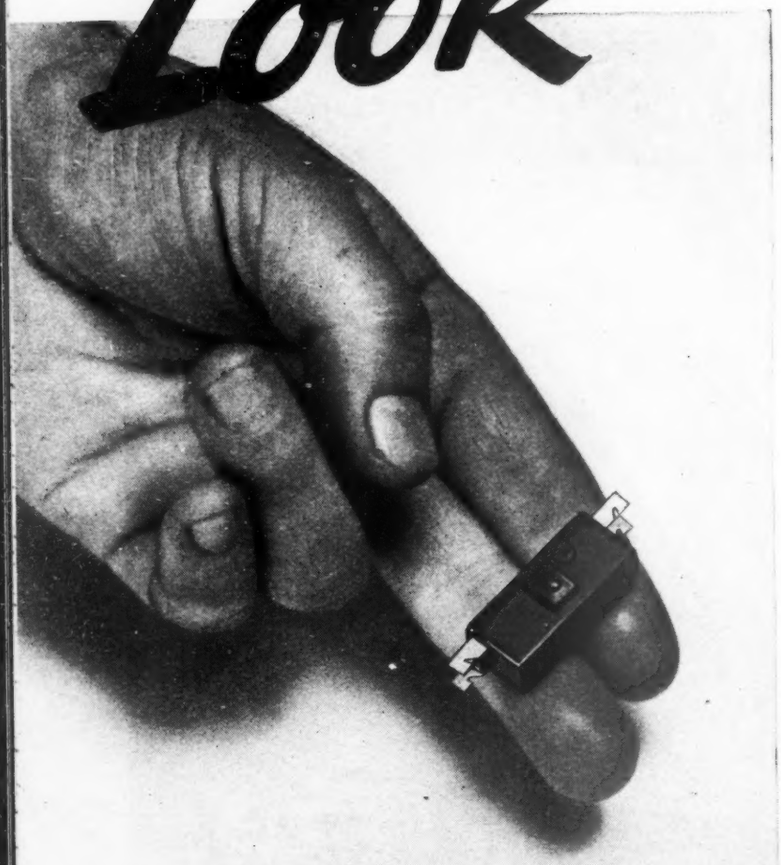

The G-E Switchette

$1\frac{3}{4}$ in. x $\frac{1}{2}$ in. x $\frac{19}{32}$ in.

WEIGHS ONLY 9 GRAMS

Available in single-circuit or two-circuit form

HAS DOUBLE-BREAK CONTACT CONSTRUCTION

MEETS THESE UNITED STATES GOVERNMENT REQUIREMENTS

1. Navy 200-hour salt-spray test
2. U. S. Govt. vibration stipulations
3. Suitable for use at altitudes from sea level to 40,000 ft
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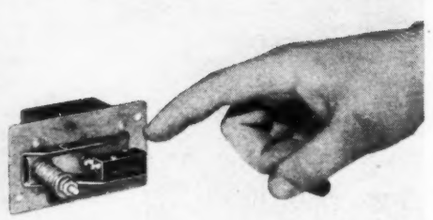
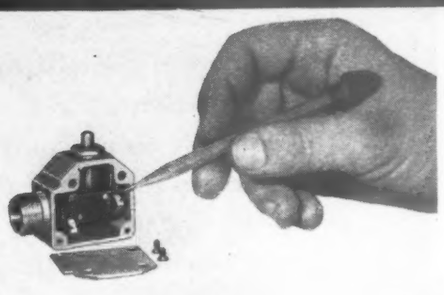
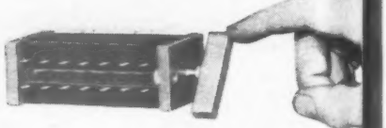
SOME OF THE MANY AIRCRAFT APPLICATIONS OF THE NEW G-E SWITCHETTE



On Atmospheric-pressure Switches



In Limit Switches



Gang Transfer Switch—14 Switchettes

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SHOP EQUIPMENT & ACCESSORIES

Oil Proof Aprons and Gloves

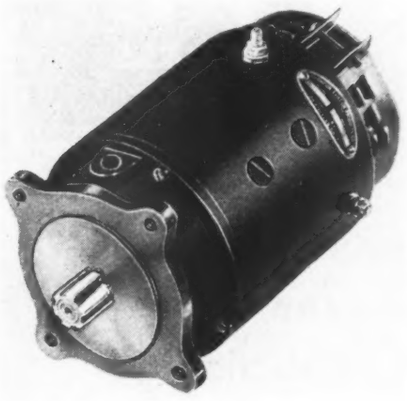
Developed expressly to prevent occupational skin diseases prevalent in many industries is a new line of oil-proof and solvent-proof gloves and aprons announced by **Resistoflex Corp.**, Belleville, N. J. The gloves and aprons are made of an extremely tough flexible material

with high resistance to tearing and abrasion, and the aprons are supplied both in a transparent type, and a heavy-duty type employing flexible fabric coated on both sides with a sturdy film of Resistoflex PVA material. According to the manufacturer they are immune to all organic solvents, including aliphatic, aromatic and chlorinated hydrocarbons, and even to that highly active inorganic solvent, carbon disulphide. The gloves are said to be successfully used in degreasing operations where protection is needed against carbon tetrachloride, trichlorethylene, perchlorethylene, benzol, or petroleum solvents and in magnaflux operations where they are unaffected by kerosene, varsol, etc. Because the gloves contain no sulphur they do not tarnish highly polished metal surfaces and are recommended for inspection of ball bearings, aircraft parts, etc.—AVIATION, *June*, 1942.

New Champion Generator

A new line of 15 volt, 25 amp. engine-driven generators for aircraft has just been introduced by **Champion Aviation Products Co.**, Los Angeles, Calif. This adds a heavier-duty unit to the former line of engine and wind-driven Champion generators. New generators meet all specifications of leading engine manufacturers, and are complete with

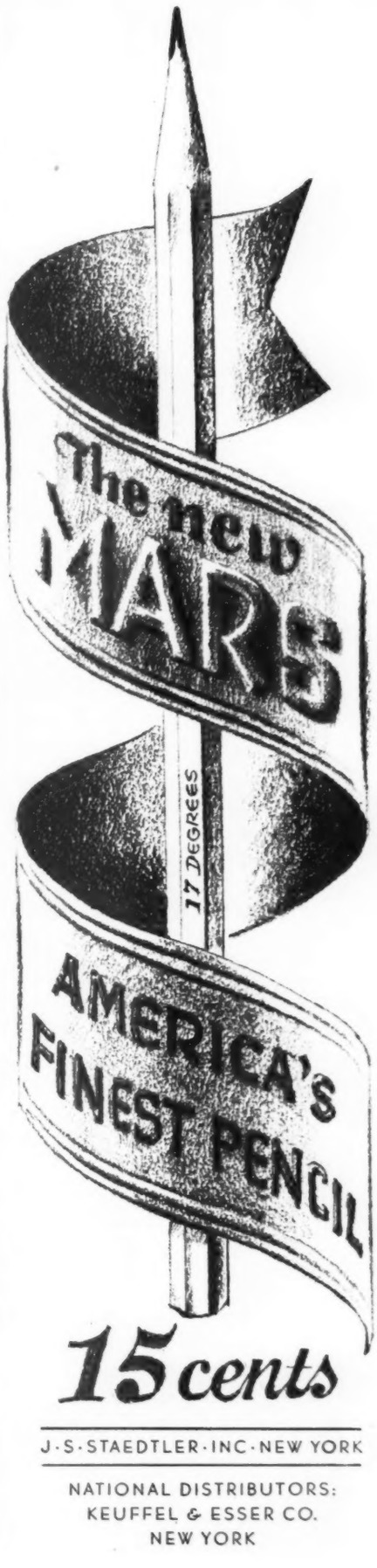
regulators mounted as separate units on the firewall. They are designed with a vent so that tubing can be run to the nearest point for air cooling. Standard SAE mounting or round plate mounting is available. Either left or right hand rotation will be furnished. The 15 volt models weigh only 22½ lb., are 9 in. long overall, with a dia. of 5½ in. They are light in weight, with dural used wherever possible. Grease-sealed ball bearings are used throughout and electrographitic brushes insure long life. Electrical parts are brass, cadmium



plated—assembled with Elastic Stop Nuts.—AVIATION, *June*, 1942.

Heinemann Circuit Breaker

A new, small circuit breaker for the protection of airplane lighting, motor, radio and control circuits has been developed by **Heinemann Circuit Breaker Co.**, 103 Plum St., Trenton, N. J., to meet the specifications of a number of aircraft manufacturers. This breaker, while retaining all the mechanical features of the larger Heinemann "Aero-Magnette" unit, has been reduced in size and weight by approximately 50 percent, measuring 2¾ in. long, 3$\frac{31}{32}$ in. high and .865 in. wide and weighing but 4½ oz. Maximum capacity of this breaker is 50 amps. and it operates on circuits up to 28 volts d.c. while its interrupting capacity is 3,500 amps. Device is fully electro-magnetic and has a definite instantaneous trip point entirely independent of its time delay characteristics. The magnetic trip with time delay gives delayed trip on harm-



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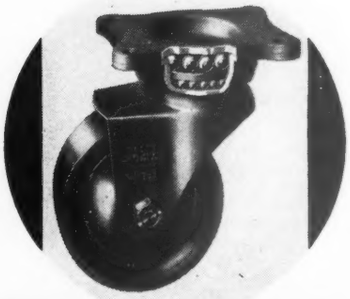

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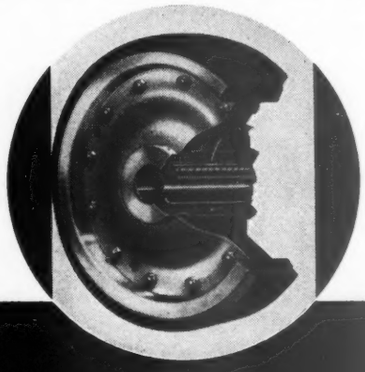

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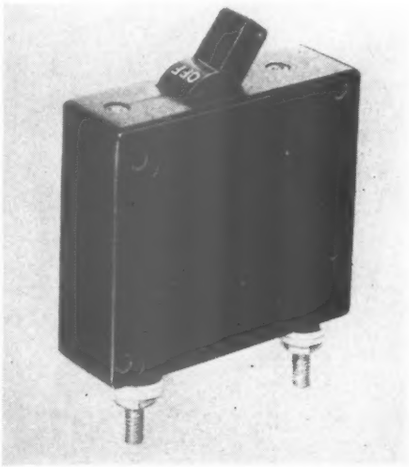
New Products

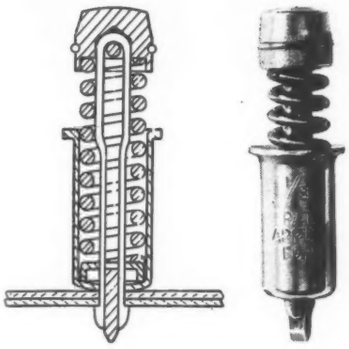
less overloads, such as passage of inrush current, but provides a high speed trip on short circuits and dangerous overloads. After breaker opens it may be reclosed at once providing current has returned to normal. Breaker cannot be held "closed" against any exist-



ing overload or short circuit. Due to absence of any heating elements, its current carrying capacity and minimum and instantaneous trip points are not affected by sudden and extreme changes in temperature. And being vibration proof and resistant to shock, constant protection is assured under all flight conditions. All parts are cadmium-plated to prevent corrosion; handle is ordinary toggle type and can be furnished with a luminous dot in the end and luminous lettering of "on" and "off" for high visibility.—AVIATION, *June*, 1942.

Scovill Skin Fasteners

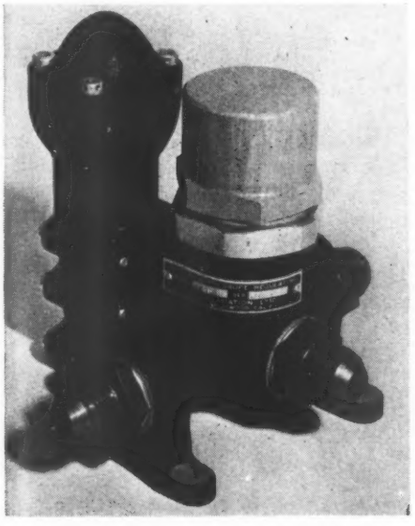
A new aircraft skin fastener, made by **Scovill Mfg. Co.**, Waterbury, Conn., offers a high factor of safety for the operator and reduces operator fatigue element. The fastener is grasped in any standard skin fastener pliers, the leader inserted in the skin sheet hole, and the leader used to line up the holes in the two skin sheets. The fastener is then compressed and locks into place with a clearly audible "snap." The fastener is compressed only at the moment of application—reducing operator high fatigue factor by 75 percent—and requires one less motion to apply, reducing attaching time by 10 percent. Fastener is sturdily made and is so



designed that final failure simply locks the nut. The Scovill Aircraft Skin Fastener is currently available in sizes for 3/32, 1/8, and 5/32 in. dia. holes.—AVIATION, *June,* 1942.

Bendix Pressure Valve

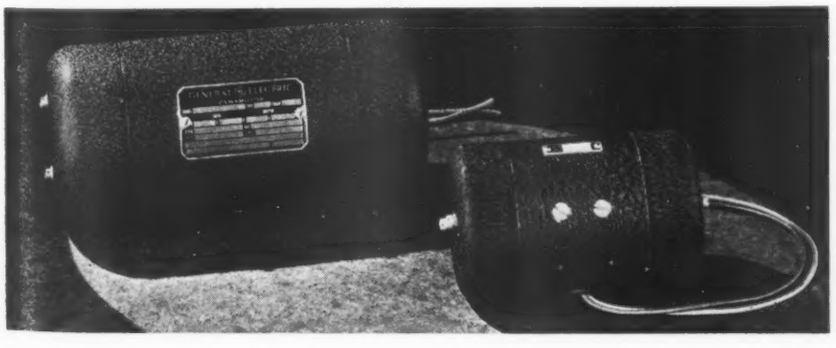
A new pressure regulator incorporating an exclusive poppet-type pilot valve which is adaptable to all pressures from 500 psi. up, has been introduced by **Bendix Aviation, Ltd.**, North Hollywood, Calif. The regulator which is also known as an "unloading valve" is reported to have been specified for



use on at least four new airplanes. The poppet valve provides absolutely leakproof operation under all conditions and will not "creep" toward the cut-in or cut-out pressures. Either at a high system bleed-off or at various flow conditions there is no appreciable shift in operating pressures. One of the most interesting features accredited to this new type valve is that it will continue normal operation down to at least -45 deg. F. All parts of the regulator are 100 percent interchangeable. Use of the poppet-type valve eliminates all lapped fits, which materially speeds up production and simplifies maintenance and repair work in the field. Service operations are further simplified by the fact that the entire relay valve assembly is demountable without disturbing installation or plumbing.—AVIATION, *June,* 1942.

New GE Dynamotors

A new line of dynamotors for communication and other service in aircraft, has been announced by the **General Electric Co.**, Schenectady, N. Y. Dynamotors perform an important task in communication work by raising battery voltage to radio transmitter or receiver voltages. Aircraft obtain their electrical power from generators driven by the main engines of the unit. The new line of GE dynamotors comprises five types, ranging from 25 to 600 watts in output, and from 3 to 31 lb. in weight. Formex wire insulation, light weight, and reliability under rigorous conditions are features. Each unit is designed for high output from a small frame size. Objectionable alternating-current ripple is kept at a value which requires a minimum of filter to provide satisfactory operation of the communication equipment. Other features are: spiraled armature punchings to reduce noise and eliminate locking effect; carefully selected ball bearings with provision for lubrication and cleaning; and a stator formed from stainless-steel tubing.—AVIATION, *June,* 1942.



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HARTZELL

MULTIPLIED PRODUCTION

Propeller and wood test club production in the Hartzell plant has multiplied in volume over and over again within the past year. Without any relaxation of precision standards it is still being increased at a rate which would have been considered beyond the bounds of possibility a few short months ago. We've a war to win!

HARTZELL PROPELLER COMPANY
PIQUA, OHIO, U.S.A.

SMOOTH?... I'LL SAY SHE IS...!

Test pilot Smith means the ship, of course! And when he says "smooth" . . . he means performance—rate of climb, maneuverability . . .

—and that most vital quality—speed!

Those few extra M. P. H. that a smooth, frictionless finish can add to a ship's speed may mean the difference between life and death —somewhere . . . sometime . . . to one of our boys.

The airplane manufacturers of America have come to know that Valspar Val-Aero Aircraft Finishes for every surface are "smooth" finishes—in every sense of the word.

VALSPAR
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A complete line of dependable Aircraft Finishes—that meet government specifications

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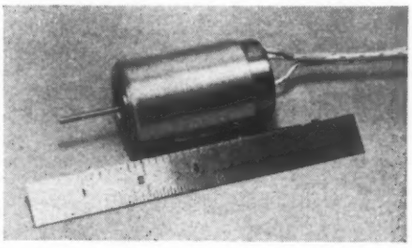
ESTABLISHED 1832

MAKERS OF THE FAMOUS VALSPAR FINISHES

Small Induction Motors

For use on intermittent or continuous duty as a drive for aircraft control equipment, trim tabs, bomb bay doors, etc., in airplanes with 400 cycle systems, **Eastern Air Devices, Inc.**, 314 Dean St., Brooklyn, N. Y., are able to supply induction motors built to specifications. Illustrated here is a 400 cycle synchronous type having a speed of 8,000



rpm., operating on 110 v., 3 phase. Horsepower at pull-in is .004 and .008 at pull-out; the torque at pull-in being .5 oz. in., and at pull-out 1.0 oz./in. There are no screws for disassembly; remove one snap ring and the rotor comes out.—AVIATION, *June*, 1942.

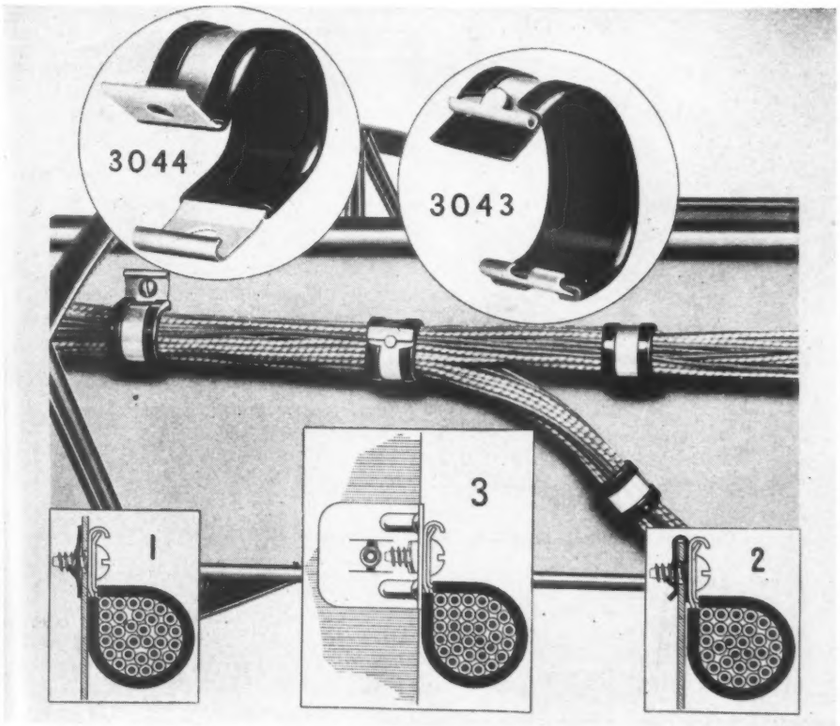
Harness Speed Clamps

For faster attachment of wire "bundles" in aircraft assembly, two new series of Harness Speed Clamps have been introduced by **Tinnerman Products, Inc.**, 2070 Fulton Road, Cleveland, Ohio. Both types have latching means which permit holding bundles or groups of wires together during subassembly

operations and while transporting the wiring to final assembly location. No. 3043 series are used at intermediate locations and where groups of wires branch off from the main bundle. No. 3044 series are supporting clamps for attachment to main structure. Harness Speed Clamps are covered with extruded plastic channels which provide the cushion. Wire abrasion tests made by a prominent testing laboratory, proved that the plastic channels will withstand abrasion over ten times longer than materials now used for wire cushions. Three methods of attachment are illustrated: (1) With standard Flat Type Speed Nut; (2) With "U" Type Speed Nut snapped over edge of flange; (3) With new Bracket Type Speed Nut for attachment at various degrees of angulation. Both types of Harness Speed Clamps are available in ten different sizes to accommodate bundles of wire in group diameters ranging from ¼ in. to 1½ in.—AVIATION, *June*, 1942.

Fenn Quick-Action Vise

Quick action plus gripping power are featured in the Fenn Quick-Action Vise put out by the **Fenn Mfg. Co.**, Hartford, Conn. Instead of a slow hand crank to



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Address:

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New York, N. Y.

Rex-Flex elbow units for cabin heater conduit. 1½" I.D. with light weight adapter at one end and thick mounting flange at other.

Speed Up Assembly with REX-FLEX

STAINLESS STEEL FLEXIBLE TUBING

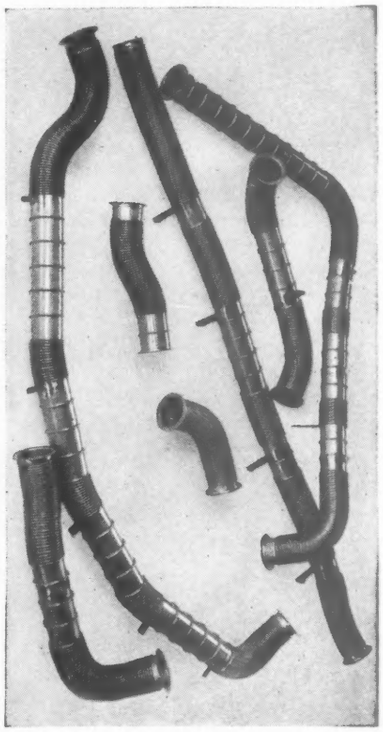
Rex-Flex Can Be Readily "Snaked" Into Place In Cramped Installations Such As Elbows and Sharp Bends, Eliminating Joints.

Aircraft manufacturers simplify many installation problems involving air ducts, blast tubes, radio shielding conduit, power plant accessory parts, oil and gas flexible lines by using Rex-Flex Stainless Steel Flexible Tubing. Extremely light in weight; bendable in multiple planes; obtainable in long lengths.

High Fatigue Value—
Heat and Corrosion Resistant

Rex-Flex Stainless Steel Flexible Tubing is available in five wall-forms, all of which can be combined in a single one-piece length, with straight walls and corrugated sections at desired intervals. Sizes 5/16" I.D. to 5" I.D. incl. Made of 18-8 (Austenitic) Stainless Steel. Fittings are attached to tube ends by circular resistance welding.

No Flux, No Flame, No Quenching—Producing Absolutely Tight, Homogeneous Assemblies

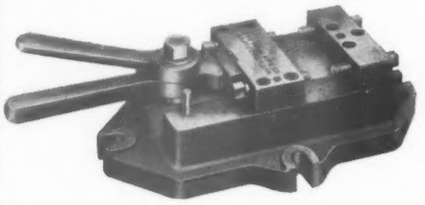


Units Shown are Typical Vari-formed Assemblies.

Data and Engineering Recommendations on Request

CHICAGO METAL HOSE
CORPORATION
MAYWOOD, ILLINOIS

close vise jaws on the work, a quick-action cam lever throws jaws together instantly, uniformly, solidly; then the eccentric handle locks the work in a doubly secure grip. Uniformity of grip can be judged by clamping two pieces



of paper—.001 in. thick—one at end of the jaws. This Quick-Action Vise is adaptable to many milling, drilling and assembly jobs. All working parts (except base, which is of fine grained, well seasoned iron for heavy duty) are of hardened, ground steel.—AVIATION, *June,* 1942.

Portable Soundscriber

Completely self-contained, including built-in microphone, a new portable dictation and recording unit has been developed by the **SoundScriber Corp.**, 82 Audubon St., New Haven, Conn. Providing secretarial help on a 24-hr. basis —you can dictate anywhere at anytime, even while traveling by car or by train where 110 volt a.c. outlets are available —the portable Soundscriber produces a clear tone whether you dictate standing up or sitting down. There is no mouthpiece to hold, the sensitive radio-type microphone gets every word. Dictation is recorded on wafer-thin disks 7 in. dia., which are practically indestructible. These disks record both sides, 15 min. to the side, may be dropped, bent and straightened, walked on, played 100 times, without destroying "sound tracks." Fifty hours of continuous recording can be filed in a space 7x7x1 in. —AVIATION, *June,* 1942.

the Beechcraft Busy Bee *

CREATED by Walt Disney especially for Beechcraft, as a badge of merit and honor to be awarded to employees of any rank or station. To qualify for the award an employee must have demonstrated, by performance, the qualities of high efficiency, interest in his work and in training for further advancement, cheerful cooperation with others, and the constant determination to *"Kill 'em with Production."*

The Beechcraft Busy Bee, rampant on a field of blueprint paper shaped in the form of a Beech leaf, embodies these qualities. Although this Beechcraft Busy Bee is busy as can be, he's not too busy to look aside to see, if instead of two jobs, he can't do three. His flaunted Beechcraft winged insigne and his cheerful grin are indicative of his high morale, but his determination is written all over his face.

Most Beechcrafters will qualify for this award. With willing spirit and determination they are pushing production rates ever upward.

* Design copyrighted by Walt Disney

BEECH AIRCRAFT CORPORATION • WICHITA, KANSAS, U.S.A.

U. S. ARMY AIR CORPS TYPE AT-10
BEECHCRAFT TRANSITIONAL TRAINER

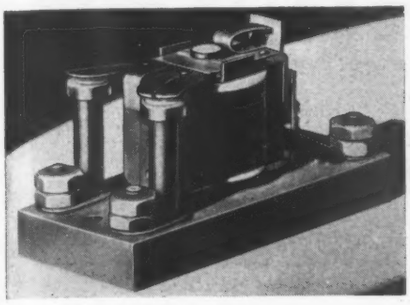
LITHOGRAPHIC ADAPTATION OF WATER COLOR BY STRATT PERRY

LITHO IN U S A

New Products

G-E Aircraft Relay

A sturdy, lightweight relay designed particularly for aircraft applications calling for operation at high altitudes under severe vibration conditions has been announced by the industrial control division of the **General Electric Co.**, Schenectady, N. Y. Designated CR2791-A100A, the relay weighs only 4½ oz., is



3⅛ in. long, 1⅝ in. high, and 1⅜ in. wide and can be mounted in any position. It is designed for mechanical frequencies of 5 to 55 cycles per second at 3/32 in. maximum amplitude (3/16 in. total travel) in any direction. Altitudes from sea level to 40,000 ft., and ambient temperature ranging from 40 deg. C to 93½ deg. C, fall within the performance scope of the relay, it is claimed. The relay has a current rating of 25 amp. at 12 or 24 v. The coil operates at 1.2 w. The single-pole, normally open contacts, are designed to stay open when the coil is not energized and closed when the coil is energized at rated voltage even when subjected to linear acceleration of 10 G in any direction, or to the vibration conditions outlined above. It is corrosion proof, having passed among other rigid tests, the Navy's 20-hr. salt-spray test.—AVIATION, *June*, 1942.

RA Unit

Simplicity and a high degree of accessibility in building up radial engine accessory sections are claimed by the **Whiting Corp.**, Harvey, Ill. for their new Type "RA" Unit. The new apparatus has a ring which clamps around the rocker boxes—at maximum diameter of the engine. Heavy rubber cushioning pads provide full protection to rocker boxes. In order to permit easy accessibility to any part of accessory section, entire assembly can be rotated 100 deg. in either direction.—AVIATION, *June* 1942.

CURTIS Air Hoists
For More Production

Assure Faster, More Efficient Lifting Save Labor, Increase Plant Capacity

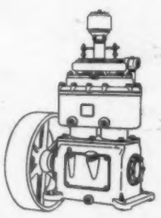
Here's the solution for many a plant faced with today's demand for increased output and a shortage of skilled labor. Curtis One-Man Air-Power Hoists make lifting easier, faster, more efficient—release men for other jobs and reduce man-power fatigue.

Curtis all steel Air Hoists cost no more than a chain block, are smooth in action, speedy, and efficient. They provide extreme accuracy of control and can handle the most delicate hoisting operations. Any workman can operate a Curtis Air Hoist — releasing skilled labor for other duties — for the hoist does the work by air power. Capacities up to 10 tons.

For complete information as to how you can step up production and lower costs in *your* plant, write for free Curtis booklet, "How Air Is Being Used in Your Industry."

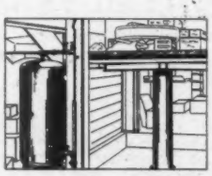
CURTIS ESTABLISHED 1854 ST. LOUIS

Curtis Pneumatic Machinery Division
of Curtis Manufacturing Company
1957 Kienlen Avenue St. Louis, Missouri



Lower your Costs for Air with Curtis Model "C" Compressors (Timken Bearing Equipped)

Reduce Handling Costs with Curtis Hydraulic Lifting Cylinders



LITHOGRAPHIC ADAPTATION OF WATER COLOR BY STRATT PERRY
BEECHCRAFT TRANSITIONAL TRAINER

HOW MANY FOOT CANDLES FROM HERE TO VICTORY?

TODAY better working daylight is a major offensive weapon. MILLER Continuous Wireway Fluorescent Lighting System provides it . . . 50 foot candles, 100 or better, to speed production . . . plus noteworthy savings in power, dollars, manhours and critical metal.

MILLER 50 FOOT CANDLER and 100 FOOT CANDLER will put 50 foot candles, 100 or better on every working surface in your plant. MILLER TROFFERS will duplicate that performance in your plant office and drafting room.

Science says your men will work better, faster, more accurately under this quality of illumination. Field facts on MILLER installations confirm this.

But that isn't all.

It is significant, for instance, that the MILLER Fluorescent System delivers maximum light output per kilowatt . . . so vitally important today in Uncle Sam's power conservation program.

And, speaking of savings, don't overlook the MILLER *continuous wireway* (containing all necessary operating auxiliaries) which permits reductions of from 30 to 50 per cent in installation costs . . . plus additional savings in valuable manhours.

Finally, engineering surveys show a saving of up to 47 per cent of copper, steel and other critical metal may be obtained when the MILLER Continuous System is employed, taking into account all items (power plant, distribution, controls, wire, etc.) making up the *complete* lighting installation.

If you are sparing no effort to speed war production . . . *write now for full details.* (Representatives in principal cities.)

THE MILLER COMPANY
MERIDEN, CONN.
Pioneers in Good Lighting Since 1844
• MILLER offers a complete line of filament and fluorescent lighting equipment

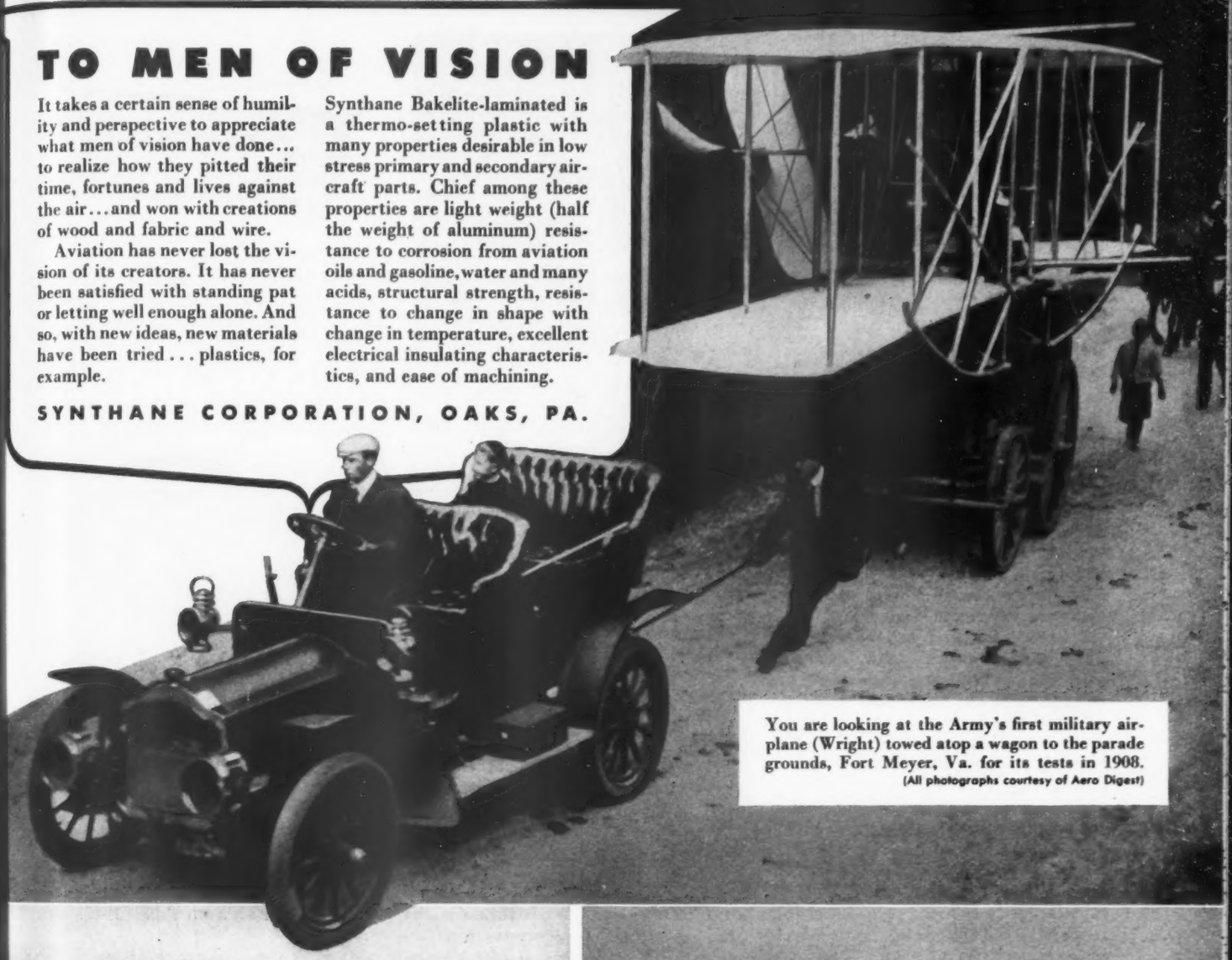
TO MEN OF VISION

It takes a certain sense of humility and perspective to appreciate what men of vision have done... to realize how they pitted their time, fortunes and lives against the air... and won with creations of wood and fabric and wire.

Aviation has never lost the vision of its creators. It has never been satisfied with standing pat or letting well enough alone. And so, with new ideas, new materials have been tried . . . plastics, for example.

Synthane Bakelite-laminated is a thermo-setting plastic with many properties desirable in low stress primary and secondary aircraft parts. Chief among these properties are light weight (half the weight of aluminum) resistance to corrosion from aviation oils and gasoline, water and many acids, structural strength, resistance to change in shape with change in temperature, excellent electrical insulating characteristics, and ease of machining.

SYNTHANE CORPORATION, OAKS, PA.



You are looking at the Army's first military airplane (Wright) towed atop a wagon to the parade grounds, Fort Meyer, Va. for its tests in 1908.
(All photographs courtesy of Aero Digest)

First successful "tractor type" airplane in this country. Built by Waldo D. Waterman in San Diego in 1911. Previously all American planes were "pushers" with engine and propeller at the rear of the pilot.

The Fowler-Gage hydroaeroplane with which Robert G. Fowler made the first crossing of the Isthmus of Panama in April 1913. Fowler ran out of gasoline and had to make a "dead stick" landing.

THE AVIATION INDUSTRY *OK's* SYNTHANE

Bakelite-laminated for

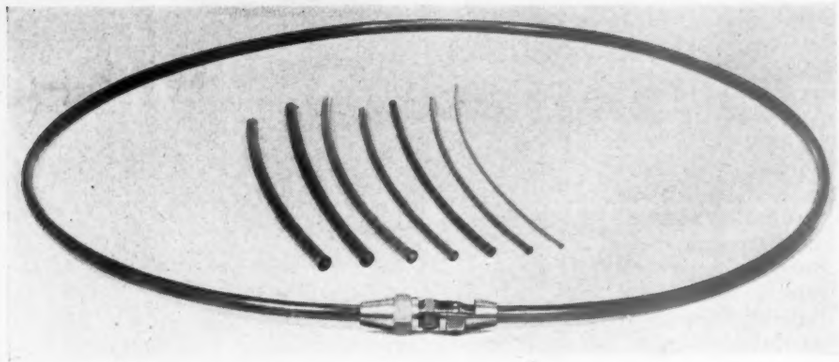
LIGHT WEIGHT with Structural Strength
LIGHT WEIGHT with Corrosion Resistance
LIGHT WEIGHT with High Dielectric Strength
LIGHT WEIGHT with Ease of Machining

SYNTHANE TECHNICAL PLASTICS

SYNTHANE
Bakelite — Laminated

SHEETS • RODS • TUBES • FABRICATED PARTS • SILENT STABILIZED GEAR MATERIAL

Materials to remember, specify and use for aircraft parts



New Products

Saran Tubing

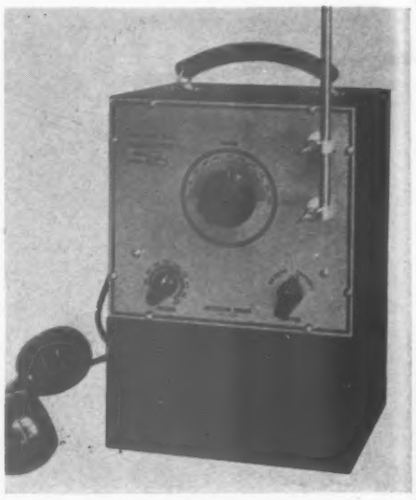
Suitable for a variety of applications, including fuel and oil lines, Saran tubing, fabricated by **Acadia Synthetic Products Div.**, Western Felt Works, 4115 Ogden Ave., Chicago, Ill., may have a specific use as a carrier of de-icing fluids in aircraft or as an air conductor in mechanical de-icing equipment in wings and tail. A thermoplastic resin having a specific gravity of 1.6-1.75, a tensile strength up to 60,000 psi., and heat resistance (continuous) of 160-200 deg. F.—the softening point being between 210-325 deg. F.—Saran is also available in molded parts, sheets, and extruded shapes. Tubing and sheets are made for the purpose of substituting for copper and the resin may be molded for use as gasoline floats, gaskets and diaphragms. In sheet form it may be used for chemical tank linings, engraving plates, etc. This resin is as resistant to corrosive effects as the majority of metals, and in specific cases will be found when subjected to elevated pressures for short periods of time. For example, Saran tubing of ¼ in. o.d. and .035 in. wall did not bulge or rupture when heated to 212 deg. F. and subjected to 200 psi. air pressure for 13 hrs. Acadia Synthetic Products has been licensed by Dow Chemical Co. to fabricate this interesting resin into the various forms.—AVIATION, *June*, 1942.

Wales Punch, Die Holder

A new model Wales Punch and Die Holder that punches holes per unit has been announced by the **Strippit Corp.**, 1200 Niagara St., Buffalo, N. Y. These new self-contained die holders provide exact holes for riveting small parts to channeled or flat material. With Wales individual holders these series of three holes can be punched in a straight line or at any angle according to the set-up of holders on rails or T-slotted plates. Nothing is attached to the ram of the press. With punch and die built into the same holder, constant alignment is assured for the life of holder. Usual long die-setting time is cut from hours to minutes. All that is necessary is to lock holder in position on rail or T-slotted plate and start punching. No further adjustments required. Wales holders can be reset or removed quickly to provide practically unlimited patterns.—AVIATION, *June*, 1942.

UF-1 Transceiver

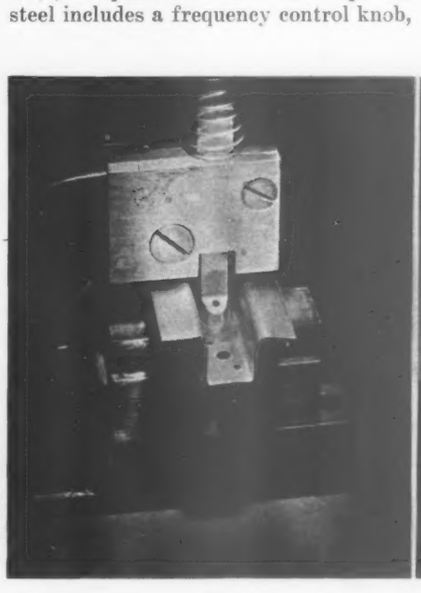
Model UF-1 completely self-contained ultra-high frequency transceiver, which up to present time has been sold exclusively to foreign governments, is now available for sale in this country. **Jefferson-Travis Radio Mfg. Corp.**, 380 Second Ave., New York, N. Y., has built this instrument on order of the "Walkie-Talkies." The UF-1 is a ½ watt transceiver contained in a black steel carrying case 11x8x6 in. The entire equipment weighs approximately the same as the average portable receiver, about 16 lb. If desired it may also be operated by a vibrapack working from a 12 volt external battery. The model consists of a three-tube transceiver working in the 60 to 75 mc. frequency range. Chassis is of cadmium plated steel, and panel of etched chrome plated steel includes a frequency control knob, volume control and "on-off" switch, as well as send-receive switch. Included, as standard equipment, is the canvas military-type covering which provides pockets for handset, antenna and battery cable. Complete removal of cover

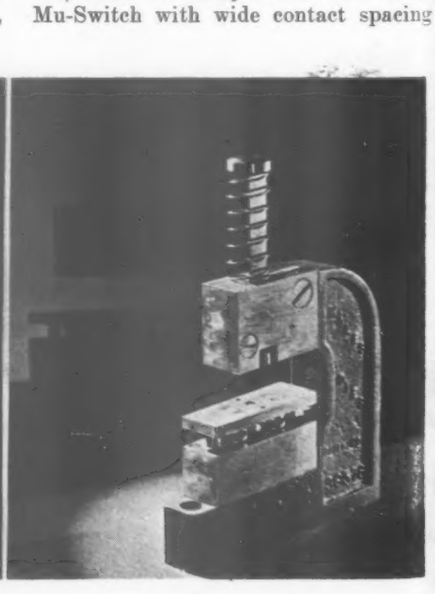


is unnecessary, operation of set being permitted by merely unfastening the front flap.—AVIATION, *June*, 1942.

Air Corps Type Mu-Switch

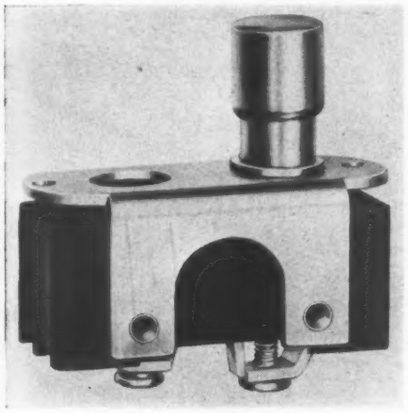
A new Air Corps type switch designed to meet requirements of Air Corps specification 94-32249 is announced by **The Mu-Switch Corp.**, Canton, Mass. Assembly consists of a basic Mu-Switch with wide contact spacing





New Products

mounted in a cadmium plated steel bracket to which is rigidly attached an over-travel plunger mechanism having a pre-travel of $\frac{1}{16}$ in. minimum and an over-travel of $\frac{1}{8}$ in. plus or minus $\frac{1}{32}$ in. Pressure required to operate switch is 1 lb. minimum and 8 lb. maximum over entire operating range. Electrical rating is 25 amps. at 28 v., d.c. 17 amps. at 125 v., a.c., and 8.5 amps. at 250 v., a.c. non-inductive loads. Wiring connections can be supplied normally open, normally closed, and single pole, double throw and special mounting lugs are provided on bottom of switch to allow



use of ring type wire connectors. New type construction said to be superior to old style Air Corps assemblies inasmuch as over-plunger mechanism was formerly mounted directly on bakelite switch itself. Much stronger construction is now available with mechanism directly attached to the steel bracket. —AVIATION, *June*, 1942.

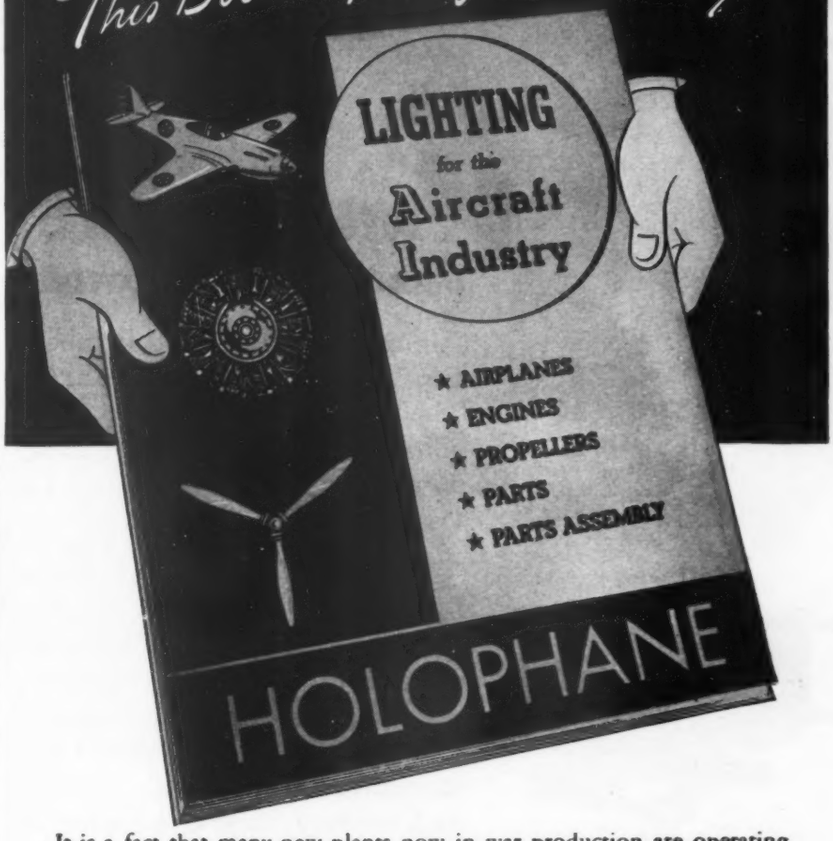
Air Hose Couplers

Designed to permit instant coupling and uncoupling of air hose lines, an automatic "plug in type" coupler is offered by **Aro Equipment Corp.**, Bryan, O. To connect the coupling, merely "push on" by inserting the plug into the socket. No twisting or turning is needed, and there is nothing to tighten. To remove, just "pull off" the coupler and it is completely detached without leakage. Due to the built-in automatic shut-off valve which efficiently controls the air flow, it is said there is no leakage at any time. Full pressure is obtained instantly when coupling is attached; the moment it is de-

For AIRCRAFT PRODUCTION EXECUTIVES:

How to Plan the Most Efficient Plant Lighting
How to Get the Full Results of Your Planning
How to Figure Cost, Maintenance, Installation

This Book is Yours for the Asking



It is a fact that many new plants now in war production are operating with a fraction (some as little as one-half) of the illumination for which they planned and paid. This waste is unnecessary . . .

The new bulletin "LIGHTING FOR THE AIRCRAFT INDUSTRY" contains:

- *Comprehensive information on processes and economy in maintenance . . .*
- *Accurate tables for arriving at costs and economic comparisons of various lighting methods . . .*
- *Easy-to-use illumination charts (available for the first time) which give pre-determined information of expected lighting results.*

Send today for this important reference book, prepared by the Holophane Engineering Department. No charge.

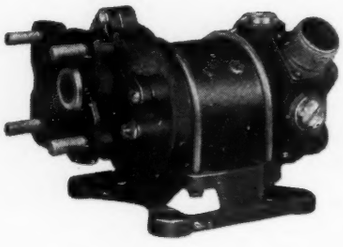
BETTER LIGHT
GREATER SPEED

Holophane
COMPANY, INC.
342 MADISON AVE., NEW YORK
Lighting Authorities Since 1898
HOLOPHANE CO., LTD., 385 YONGE ST., TORONTO, CAN.

UP AND AT 'EM!

DELCO FUEL PUMP MOTORS

America's fighters and bombers can "get upstairs" in a hurry. Their ability to climb fast and climb high will account for many an enemy plane . . . many an air victory . . . in days to come.



Safeguarding the flow of engine fuel in planes for the Army and Navy are Delco explosion-resistant fuel pump motors, conforming to latest military requirements. Their dependable performance in starting, transfer and booster duty is a factor in keeping our planes "on top."

Delco Products has been awarded the Navy "E" for outstanding armament production.

Delco Products' experience in precision machining has been applied to building aircraft equipment and ordnance material for Victory. Delco Products is proud to serve as a supplier to the aircraft industry.

DELCO PRODUCTS DAYTON, OHIO

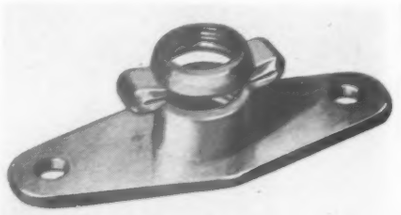
DELCO MOTORS

Division of General Motors Corporation

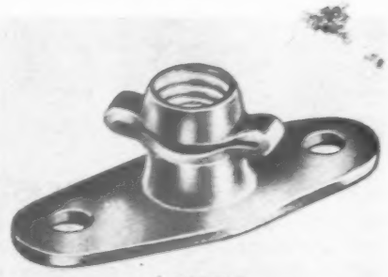
tached, the air line is automatically sealed by the valve. A swivel construction at the connecting point permits the hose to turn feebly—thus eliminating kinking and twisting, and adding greatly to the service life of the hose. Couplers are available in two sizes—$\frac{1}{4}$ in. and $\frac{3}{8}$ in. Three connectors are available for the $\frac{1}{4}$ in. coupler, including $\frac{1}{8}$ in. and $\frac{1}{4}$ in. male pipe thread, and $\frac{1}{4}$ in. female pipe thread; two connectors for the $\frac{3}{8}$ in. coupler, including $\frac{3}{8}$ in. male pipe thread and $\frac{3}{8}$ in. female pipe thread—AVIATION, *June*, 1942.

New Boots Nuts

For faster, easier riveting, the **Boots Aircraft Nut Corp.**, 952 E. Main St., Waterbury, Conn., has turned the "wing" angle 45 deg. on the wing style self-locking nuts. As can be quickly seen in the "before and after" photographs the rivet holes are now more accessible. The new feature will help speed assembly and reduce maintenance time without sacrificing any of the fastener's efficient performance. This all sheet-metal self-locking nut saves 18 to 66 deg. dead weight compared to old-fashioned nuts cut from hex-bar stock, depending on the size and style. Thus, up to 60 lb. per plane may be eliminated leaving room for additional fire-power or fuel.—AVIATION, *June*, 1942.



BEFORE



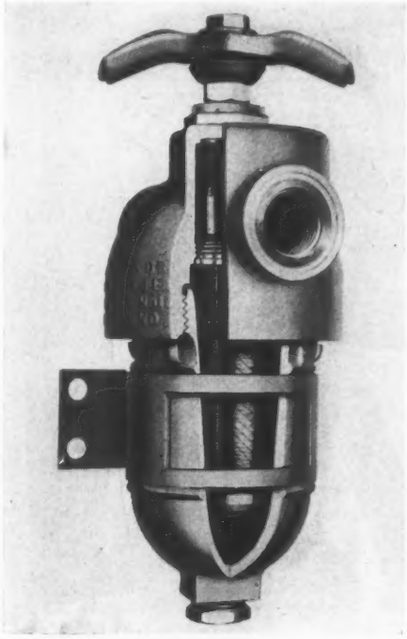
AFTER

New PurOlator Filter

An aluminum filter, constructed so operating pressures may go up to 1,500 lb., if necessary, has been brought out by **PurOlator Products, Inc.** Newark, N. J. It is said to have a bursting pressure considerably greater than the maximum specified by the users. Units

New Products

have been frequently tested, company says, that will not burst under 5,000 lb. Called model G-159J-10, this unit is usually installed in the discharge line of a power driven hydraulic pump, and takes the full flow, up to 12 gal. per min., of a system which feeds hydraulic cylinders used to operate landing gears, wing flaps, gun turrets, bomb racks, etc. The filter is designed to keep all operating valves and small orifices free of contamination during operation of the system.—AVIATION, *June*, 1942.



Jessop TCM Steel

The **Jessop Steel Co.**, 613 Green St., Washington, Pa., announces a new product—"TCM High-Speed Steel." It fully replaces 18-4-1 and is of particular importance now due to the shortage of strategic alloys which are so vital to our War Program. TCM is a low tungsten-molybdenum steel and cuts as well, or better than 18-4-1. No change in operating equipment is necessary in using TCM High-Speed Steel because it is heat treated in the same furnaces and the same atmosphere as 18-4-1 High Speed Steel. TCM steel has a slightly lower hardening temperature which contributes to a lower cost in heat treating; is lighter in weight than 18-4-1, which means more steel per dollar and more tools per lb. of steel.—AVIATION, *June*, 1942.

JUST A HANDFUL..BUT
PACKED WITH POWER
THIS AIRCRAFT DRILL by United States
MODEL 14 ARD
¼" Heavy Duty Special Drill . . . Ball-bearing
ALL THESE FEATURES JAM-PACKED INTO THIS SUPER-CONVENIENT DRILL:
universal motor, 750 to 5,000 rpm; ball-bearings in easily removed steel retainers; switch adapted to right or left-hand workers; fully streamlined with no protuberances anywhere; close-coupled; air-cooled. Easy inspection, adjustment or replacement.
A "LITTLE GIANT" in size but a "BIG" giant for power, efficiency and flexibility in adaptation to aviation construction or maintenance.
We suggest you write for details.
THE UNITED STATES ELECTRICAL TOOL CO.
CINCINNATI, OHIO, U.S.A.
United States Electrical Tools

Helpful "Staff Work"

IN THE BATTLE OF PRODUCTION

All over America, engineers and production men are converting plants to war needs. These men know they can... upon request... get helpful suggestions from us about ways to speed up the working of metals and alloys.

This helpful information has been mobilized into convenient charts, pamphlets and other printed pieces. These tools-in-type range from technical data for engineers to simplified reports on performance of alloys containing Nickel under specific operating conditions.

Here, also, are correlated latest reports from the field about selection, fabrication and uses of ferrous and non-ferrous Nickel Alloys.

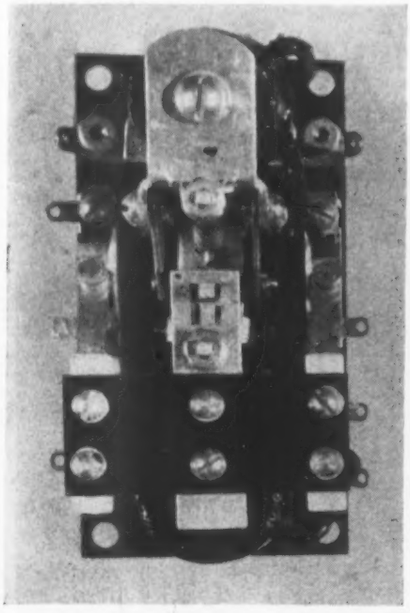
And, as further support for your battle of production, we offer personal assistance from members of our technical staff. With recent experience in many plants facing materials difficulties, these men become especially helpful. During wartime, Nickel... and information about Nickel... must go where it best serves the United Nations.

☆ ☆ *Nickel*

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

Dunco Reset Relay

A new mechanical latch-in, electrical reset relay especially designed for aviation purposes and carefully tested to withstand vibration incident to such service has been announced by **Struthers Dunn, Inc.**, 1335 Cherry St., Philadelphia, Pa. Known as Dunco Relay Type



CX3190, this unit operates from a brief impulse without the necessity of keeping the coils energized. Double-pole, double-throw contacts are rated at 6 amp. at 12 or 24 v.; d.c. An auxiliary contact breaks one coil circuit. All contacts are insulated from the frame for radio frequency. Dimensions of the unit are $3\frac{7}{8}$x$1\frac{3}{4}$x$1\frac{3}{8}$ in. Weight is 7 oz.—AVIATION, *June*, 1942.

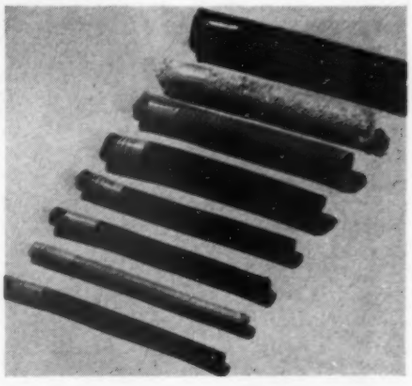
New Propeller Test Unit

A semi-portable unit, designed to test and calibrate all types of hydromatic and electric propeller governors under simulated flight conditions, is now being manufactured by **Aircraft Accessories Corp.**, 166 W. Olive St., Burbank, Calif. It is enclosed in a removable, reinforced, welded steel case, 30 in. high, 36 in wide, and 40 in. deep, and can be used either for bench or stand mounting. The case is finished with a standard army black wrinkle finish. All indicating instruments and controls are mounted on a vertical control panel at the front of the test unit. With the exception of the instruments and controls, all other components of the unit are within the cabinet. A one piece cover is easily removed to give quick access to the interior for inspection and servicing. This test unit can be used to test any of the following: Hamilton standard and hydromatic governors, all models; Curtiss electric governors, all types of direct and flexible shaft driven models, and Curtiss proportional type governors.—AVIATION, *June*, 1942.

Wiremold Flexible Tubing

Recommended for electrical circuits on airplanes and also used as a protective covering for fuel and oil lines, Wiremold flexible seamless woven tubing is made by the **Wiremold Co.**, Hartford, Conn. Tubing of standard construction and standard finish ranges in size from $\frac{1}{8}$ in. id. to $1\frac{1}{2}$ in. id. in multiples of $\frac{1}{16}$ in. Company also furnishes tubing in special sizes, constructions,

and finishes to meet specific requirements. Where rigidity and thinness of wall, as well as flexibility are required, company has made a specialty of developing tubing with wire filler. Warp may be of cotton, asbestos, rayon or Fiberglas, and where rubber or metallic



tubing is used as a protective covering for wires, feed lines etc., the Wiremold seamless tubing has proved a suitable substitute.—AVIATION, *June*, 1942.

WINDOW SHOPPING

Slotmaster—New edition of 4-page catalog on the Universal Slotmaster. Experimental Tool & Die Co., 12605 Greiner, Detroit, Mich.

Ten Extra Hands—Further information and illustrations of Hydra-Grip, a self-contained work holder for multi-chuck operations. Set-up time is slashed to absolute minimum—ten pieces handled at one time; loading and unloading operations almost instantaneous. Made and distributed by Interaircraft Machine Shop, Inc., 3851 Medford St., Los Angeles, Calif.

Electricians' Gloves—A four-page catalog section on its electricians' gloves, made by the Anode process from liquid latex has just been published by The B. F. Goodrich Co., and is now available upon request. Describes the manufacturing process and its advantages, illustrates the types of gloves company makes, and the rigid tests which have to be passed before the gloves are certified for use. B. F. Goodrich Co., Akron, Ohio.

Variable Voltage Planer Drive—For increasing planer production in industrial plants, variable voltage planer drives with a 30 to 1 speed range are described in a new four-page folder announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Metal Cleaning in Wartime—Interesting and timely booklet outlines in detail the metal cleaning problems of production for war and indicate the Magnus products best suited for use in each. Magnus Chemical Co., 257 South Ave., Garwood, N. J.

Oxy-Acetylene Tips—April issue of an old friend; how to set up your welding and cutting equipment, how to cut heavy steel sections, and other items of interest are set forth in readable, illustrated style. The Linde Air Products Co., 30 East 42nd St., New York, N. Y.

Chalk Talk—How to get the most work out of your Doall is illustrated by means of sketches, as on a blackboard, showing tips on various methods of Doall machine tool use. Continental Machines, Inc., Minneapolis, Minn.

Lycoming Aircraft Engines—Newly released is a comprehensive folder depicting flight views of the numerous types of Lycoming-powered training planes used in Army and Navy pilot training and in civilian instruction. These include light planes such as Aeronca, Funk, Piper, Taylorcraft and Skyfarer, Spartan and Morrow types; the Stinson L-49 and Beechcraft, Cessna and Curtiss bi-motored transitional trainers. Department B. Lycoming Division, The Aviation Corp., Williamsport, Pa.

Kidde News Features—A collection of stories and pictures on compressed gases, to be issued monthly during 1942. Walter Kidde News Bureau, 122 E. 42nd St., New York; N. Y.

Tungsten Electrodes—Pamphlet on atomic hydrogen welding. Essence of the process is the electric arc in which hydrogen is converted from the molecular to atomic state. Atomic hydrogen is extremely active and quickly combines with any oxides present on the metallic surfaces, at the same time shielding the weld area from oxidation by air. Vascoloy-Ramet Corp., North Chicago, Ill.

Kennametal—Booklet entitled *Instructions for Users of Kennametal Steel Cutting Carbide Tools*, covering selecting, designing, using, brazing and grinding. Illustrated with line drawings. McKenna Metals Co., 1000 Lloyd Ave., Latrobe, Pa.

Ohmite Stock Items—New, up-to-date, 16-page catalog listing over 1,000 stock items in rheostats, tap switches, chokes, resistors and attenuators. Ohmite Mfg. Co., Dept. 7H, 4835, Flournoy St., Chicago, Ill.

NO SOONER SAID *than Done*

THIS BROCHURE will help any producer of War Materials determine where Lyon facilities can help him accelerate production. A copy is yours for the asking.

MORE THAN A YEAR'S EXPERIENCE EXPEDITING WAR CONTRACTS FOR *FABRICATED METAL PARTS*

● Organization and experience are the two primary factors responsible for Lyon's ability to move fast and effectively at each step in the handling of Prime Contracts and Sub-Contracts for unusual fabricated sheet metal products.

Lyon field men are specially trained to gather all pertinent facts for matching our facilities with your needs. At daily meetings of our War Production staff—where all major departments are represented—plans are laid and synchronized for speedy handling of every commitment. Well into its second year of continuous operation, Lyon's War Production Staff provides a working knowledge of War Order Requirements and Procedures difficult to duplicate.

Ready to advance the staff's plans into production is one of America's best equipped organizations for fabricating sheet metal. Lyon's big, modern plants cover an area of over half a million square feet. Completely equipped toolrooms assure prompt production and maintenance of all necessary dies and jigs.

So, if you have products or parts of products to be made for Uncle Sam that require fabrication of No. 8 to No. 30 gauge sheet steel . . . turn to LYON for ACTION. We have the facilities to make such products in large quantities . . . to have them ready when you need them. Write for brochure, "Craftsmen in War Production."

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LYON METAL PRODUCTS, INCORPORATED

Subcontractors Section

New Opportunities For Subcontractors

Loan Regulation Liberalized to Aid Conversion

THE NEED for subcontractors continues to grow. Mounting evidence of this fact is apparent despite the nothing-short-of-miraculous conversion job that American industry has performed in a few short months.

Perhaps the outstanding indication is provided in new government financing regulations which make it easier for both sub- and prime contractors capable of contributing to the war effort to secure needed capital.

Such financial aid may be secured under Regulation "V", the WPB reports, whereby bank loans may be made to industry under guarantee of the War or Navy Departments or the Maritime Commission.

One of the chief objectives of the new plan, WPB reports, "is to provide for the financing of war contracts which may be awarded to companies that lack sufficient capital, but that are otherwise equipped to handle the business. For instance, a contractor may have a plant that is capable of conversion from peacetime to wartime production, and may also have management that is sufficiently capable and responsible to handle military contracts. Yet, because of lack of capital, such company may be unable to take part in war production.

"This new method of financing will enable such companies to participate in the war effort, and it is expected that the commercial banks and financial institutions of the country will be instrumental in handling such financing."

According to advices of the WPB Bureau of Finance, such loans will

Westinghouse Photo

SUBCONTRACTING GOES TO COLLEGE

Purdue University students operate screw-cutting lathes, producing parts for war machines. Recently only a practice shop for engineering students, it is now a war factory under terms of a subcontract placed with the University by Westinghouse. The American College Bluebook lists twelve colleges offering aeronautical engineering courses among 111 schools giving civil, electrical or mechanical—or all three—courses, indicating availability of much more equipment similar to that shown.

LYON
Shop Equipment
For War Industries

● Results in plant after plant prove these Lyon Steel Shop Equipment items contribute to faster output. They reduce fire, sabotage and water hazards . . . save man and machine hours by preventing the misplacing and loss of tools and injury caused by splinters or nails. Write for catalog.

LYON Service
SHOP EQUIPMENT

carry a maximum interest rate of 5 percent and, in many cases, it is expected annual interest will not exceed a rate of 4 percent.

Subcontract Conversions Cited

Meanwhile, conversions from peace to wartime operations have continued at an accelerating pace, WPB reports show. A company which manufactured paper bag and box making machinery turned its salesmen on the trail of subcontracts some two years ago; the first war order was landed a year later, calling for machining of a variety of bits and pieces for an aeronautical prime contractor. Since then it has acquired some prime contracts including a $100,000 order for aircraft engine test stands and the manufacture of a variety of tools for airplane engine field maintenance and repair.

Another recent conversion cited by the board is that of a small fabricator of precision hardware for musical instruments which is now engaged in making electrical instrument panels for aircraft and marine engines in addition to an order for 35,000 aircraft parts of six different varieties.

Idle Machinery Wants War Work

The following, in brief outline, are manufacturing facilities, with their locations, recently offered to the aircraft industry through this publication. AVIATION will be glad to forward promptly to the interested firms inquiries from prime or subcontractors who want more detailed information on the manufacturing facilities listed. Similar mention in this section is available both to companies wishing to secure or place subcontracts.

101. New York City——Special machinery manufacturer; approx. 12,000 sq.ft. available for light metal work; plant well equipped with modern tools.

102. Long Island City, N. Y.——Manufacturer of vending machines. Entire plant 50,000 sq.ft. available. Modern machine and sheet metal shops.

103. Indianapolis, Ind. —— Manufacturer of Veneers. Equipped to produce complete assemblies or special plywood parts.

104. Chicago, Ill. —— Manufacturer of amusement machines; 60,000 sq.ft. available; metal working and woodworking shops; equipped to produce electrical assemblies.

105. Belleville, N. J.——Manufacturer of merchandising machines; now working on prime and subcontracts; can

A THOROUGHLY COMPETENT ORGANIZATION
SPECIALIZING IN SERVING THE PRIME CONTRACTOR

EXHAUST COLLECTORS
AND OTHER STAINLESS STEEL AIRCRAFT COMPONENTS
SHEET ALUMINUM FABRICATION · TANKS · COWLING · ETC.

AIRCRAFT COMPONENTS, INC.
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PROMPT ON-SCHEDULE DELIVERIES. WRITE
OR WIRE FOR DETAILS OF OUR FACILITIES

Everything in Fabric!

BLIND FLYING HOODS	ANYTHING OF FABRIC
ENGINE COVERS	COCKPIT ROLLS
LANDING GEAR, TAIL WHEEL	COWL PADS
AND STICK BOOTS	STRAPS
FUME PROOF SLEEVES	PAD ASSEMBLY HEAD RESTS
HUB COVERS	CORD ASSEMBLIES
CUSHIONS	WING COVERS
CRASH PADS	FUSELAGE COVERS
FLOOR COVERINGS	CONTAINER ASSEMBLIES
SEATS	FLEXIBLE GUN HEAD CUSHIONS
LIFE PRESERVER CUSHIONS	GUN BLAST BOOTS

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No matter what you want, in this classification, in fabric or leather, contact us — we produce the highest quality work only

"Everything in Fabric" BY POTTER
Made to your Specifications

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handle additional work; complete sheet metal working equipment.

106. *Chicago, Ill.*——Metal working company; machine shop and sheet metal shop; tool room; equipped to produce small stampings, rolled shapes, tubing, special forming, and assembly work.

107. *Manchester, N. H.*—— Experienced woodworkers; 18,500 sq.ft. of production area; equipped to produce wood and plywood parts.

108. *Chicago, Ill.*——Manufacturer of coin controlled amusement and vending machines, is interested in securing subcontracts for small aircraft assemblies such as junction boxes or other electrical work. Equipment includes Hendy and South Bend lathes; a variety of milling machines; grinders; hand screw machines; shapers; and punch and drill presses.

109. *Huntington Park, Calif.*——Manufacturer of aircraft hydraulic actuating assemblies and accessories is quadrupling all present plant facilities. Additional employees are being trained to meet increased production demands. Company has long experience in the manufacture of precision parts of the same kind that are used in making hydraulic actuating assemblies. Actuating assemblies of many types, including wing-flap, nose wheel, landing gear, bomb door, etc., are being manufactured on a production basis.

Inquiries should be addressed to AVIATION, 330 W. 42nd St., New York, mentioning the item numbers shown above.

Attention Subcontractors

The War Production Board is seeking subcontractors for a variety of aircraft parts, detailed information on which can be obtained at any of the WPB Contract Distribution Offices.

Among those sought are subcontractors for aircraft parts which require a 5½ in. automatic screw machine; No. 4 W. & S. hand screw; arbor press; gear cutter; broaching machine; drill press and external and internal grinders.

Another prime contractor seeks shops with 5½ in. Cleveland automatic screw machines.

A subcontractor is sought to make aircraft terminals and turnbuckles of stainless steel which can be purchased from the prime contractor; while another manufacturer wants to subcontract steel rotors and rotor blades for aircraft fuel pumps.

MARTINDALE ROTARY FILES and BURS are:

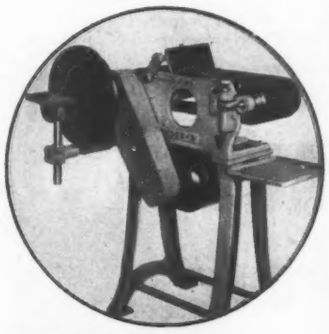
1. Available in 300 sizes.
2. Usually shipped 6 days after orders are received.

Write for 12-page Bur Bulletin

MARTINDALE ELECTRIC CO.

1418 Hird Ave., Cleveland, Ohio

New!



DUPLEX-B-M Combination Band and Disc Grinder

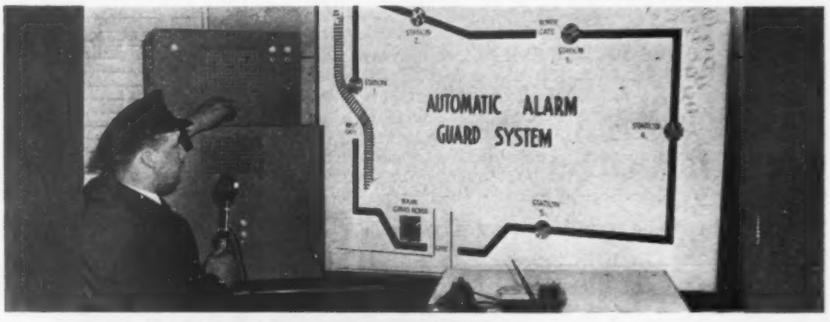
Improved and streamlined—heavily built for increased production and lower finishing costs.

Motor Driven Ballbearing throughout—Fully enclosed adjustable drive. Large disc grinding table.

Write for illustrated folder for this and other size grinders.

WALLS SALES CORP.

95 WARREN ST. • NEW YORK, N. Y.



DANGER reported and LOCATED

● A.A.I. Automatic Alarm Systems, now guarding great American defense industries, not only give instant warning of danger but actually locate the zone of disturbance. Saboteurs attempting to scale or cut through wire guard fence are "heard" by tiny "robot sentries," or detectors, which flash and sound immediate signals to police or military headquarters where lights indicate that particular section of fence where entry is being attempted. A.A.I. Automatic Alarms multiply many times the efficiency of plant protection, aiding human guards in patrolling miles of high wire fence even during difficult periods of blackout, storm and fog. These systems may be installed by plant engineers, require little or no servicing and are available at a cost permitting even small factory installation.

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Licensed under DuPont and Astatic Patents

AUTOMATIC ALARMS *Incorporated*

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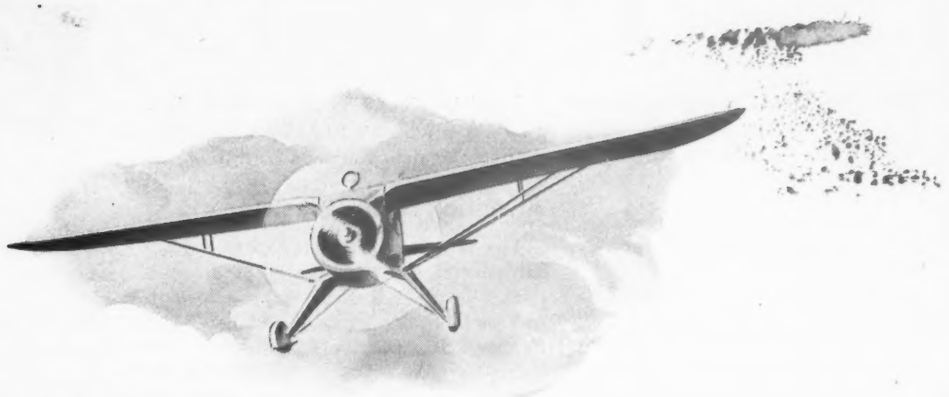

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—Reliable Radio Equipment!

Meet RCA's "C. A. P. Family" of aviation radio transmitters, receivers, and antennas . . . soundly-engineered, ruggedly-constructed, low-cost units, ideally matched to the requirements of patrol flights!

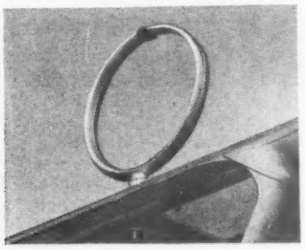
RCA Model AVR-100 and AVR-101 Receivers—Barely a handful, yet the AVR-100 is a sensitive 2-band superheterodyne, with amazing performance. Covers 195-405 kilocycle Weather-Beacon band, and 550-1500 kilocycle Broadcast band. Easily mounted in standard A-N instrument-panel opening, or fits in package compartment. Model AVR-101 is similar but covers only the 195-405 kilocycle Weather-Beacon band.

★ KEEP BUYING WAR BONDS ★

FOR FINEST EQUIPMENT OR SERVICE
...See Your RCA Distributor

Aeronautical Radio Co.	6054 S. Cicero Ave., Chicago, Ill.
Aeronautical Radio Co.	Roosevelt Field, Mineola, L. I., N. Y.
Aircraft Instrument Service	Detroit City Airport, Detroit, Mich.
Flight, Inc.	Municipal Airport, Cleveland, Ohio
Aviation Supply Corp.	Municipal Airport of Atlanta, Hapeville, Ga.
Buffalo Aeronautical Corp.	Buffalo Municipal Airport, Buffalo, N. Y.
Chapman Air Service	New Orleans Municipal Airport, New Orleans, La.
Culver's	231 North First Ave., Phoenix, Arizona
Cutter-Carr Flying Service	Box 274, Albuquerque, New Mexico
Missouri Aviation Corp.	416 Admiral Blvd., Kansas City, Mo.
Northwest Air Service	Boeing Field, Seattle, Washington
Pacific Airmotive Corp.	Municipal Airport, Oakland, Calif.
Pacific Airmotive Corp.	Lockheed Air Terminal, Burbank, Calif.
Rocky Mountain Aircraft Radio Co.	3023 Cherry, Denver, Colo.
Southwest Airmotive Co.	Love Field, Dallas, Texas
St. Louis Flying Service	Lambert Field, St. Louis, Mo.
Stinson of Montana	Municipal Airport, Helena, Mont.
Thompson Flying Service	Municipal Airport, Salt Lake City, Utah
Van Dusen Aircraft Supplies, Wold-Chamberlain Airport, Minneapolis, Minn.	
Van Dusen Aircraft Supplies	Waterloo, Iowa
Wallace Aircraft Company	Clarcona, Florida
Wings Field, Inc.	Ambler, Pa.
A. W. Whitaker	Swan Island Airport, Portland, Oregon

RCA Model AVR-15 Receiver—capable of coping with even the toughest "instrument" conditions—contains a separate Traffic-Control Switch to put you instantly on the Traffic-Control Frequency regardless of the setting of the main tuning dial.



RCA Model AVA-122 Loop Antenna, for direction-finding and "homing." Matched to AVR-100 and 101 Receivers and is adaptable to other receivers of sufficient sensitivity. Full electrostatic shielding reduces precipitation-static.

RCA Model AVT-111 Transmitter, operates from 6 or 12-volt storage batteries through efficient AVA-126 Vibrator Power-Supply which also operates AVR-100, AVR-101 or AVR-15 receivers. Efficient, two-band transmission.

RCA Model AVA-120 Antenna System. Highly efficient system adapted to transmission from lightweight planes, at a low cost. One-hand reel operation, with special construction to prevent accidental release on ground.

FOR AVIATION RADIO

RCA MANUFACTURING CO., INC., CAMDEN, N. J.

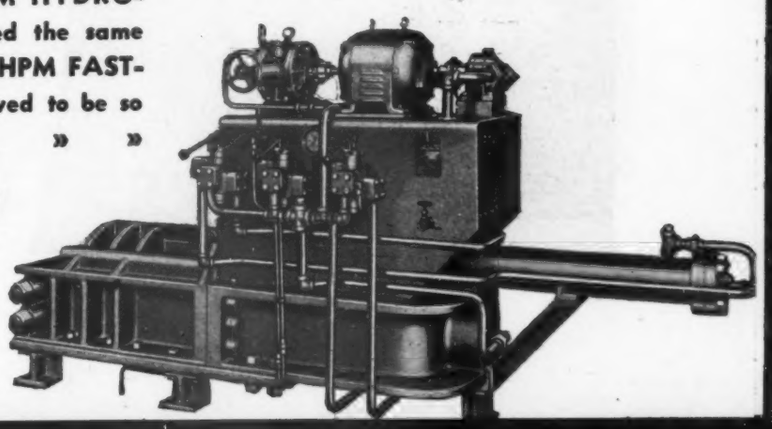
One of two HPM Scrap Metal Balers installed by Douglas Aircraft Co., Inc. for baling dural scrap.

HPM BALING PRESSES handle Scrap Duralumin equally as well as steel!

Reduce your scrap metal trimmings to 5% or 10% of their original bulk with a self-contained hydraulic HPM SCRAP METAL BALING PRESS . . . used universally by the aircraft and metal working industries. Not only will an HPM BALER increase the value of your scrap, but also it will permit easier handling because of the compact size of the bales. ● Powered by the HPM HYDRO-POWER Radial Pump, each HPM Baler is assured the same reliable trouble-free operation as the famous line of HPM FAST-RAVERSE Metal Working Presses which have proved to be so essential in today's all-out Victory production. » » »

SPECIFICATIONS

End Platen Tonnage	140
Side Platen Tonnage	100
Box Size (W. x L. x Ht.)	24" x 48" x 16"
Minimum Bale Size	10" x 10" x 16"
Average Weight of dural bale (lbs.)	90
Dural bales per hour	14



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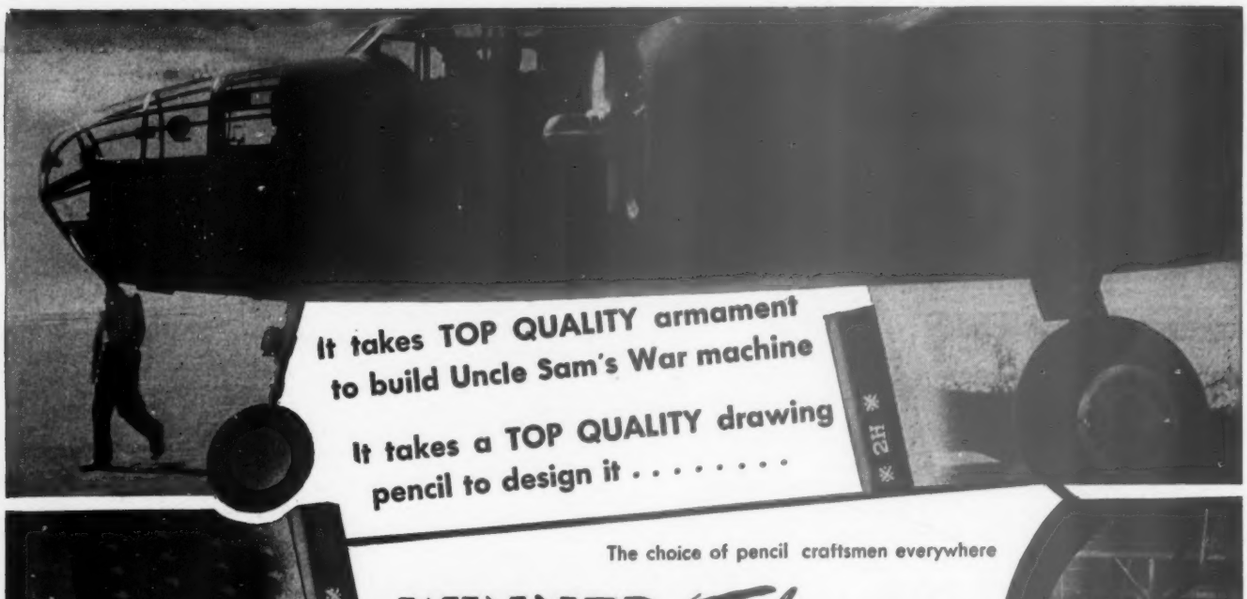

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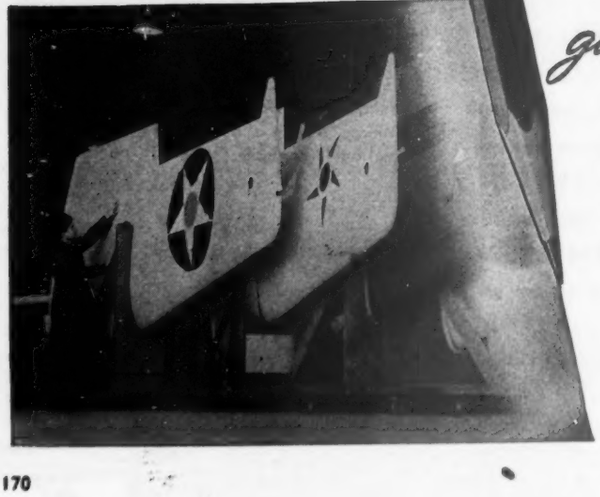

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Side Slips

• AS EVERYBODY KNOWS, most inside news comes from cocktail bars. Introducing a fresh note into this informative page, we give you the first and only lowdown originating in church.

One of the girls in our office goes to church, and she got it from her minister, who got it from another minister, who got it from a refugee.

Rudolf Hess went to Hitler and told him he didn't think Germany could win, and that peace ought to be made with England at once.

This made Hitler mad, and he gave Hess the evil eye and said in a low menacing voice, "You go home and I'll come and get you." Well, Hess probably felt just as you would if Hitler said he'd come and get *you.*

So Hess called up Paul Messerschmitt and told him what a fix he was in, and Paul lent Hess one of his famous airplanes to fly to Scotland.

And then Messerschmitt disappeared, and hasn't been seen or heard of since. And, Hess was right. Hitler did come to get him—with an armed squad—too late. That's hot off the pulpit.

• NINETEEN-FORTY-TWO, so far as we know, is the first year in which anybody ever looked forward to getting a calendar in the mail. The usual practice is to open them, tuck them in the waste basket, and forget the whole subject till next year.

But this year, a lot of people actually waited for a certain calendar. It was Thompson Products, who scored last year with series of 12 pictures of planes of the first decade of this century.

Thompson hit the jackpot again in 1942, with a series called "The Golden Decade" — 1920–1930. It begins with the Liberty-powered DH-4 which carried the first transcontinental mail, and ends with the *Question Mark,* 1930.

This new job, and the first one too, were done by Charles H. Hubbell, of Fairview Village, Ohio. Usually you find two kinds of airplane artists: one who can make them look as if they had a soul and were going somewhere, and the other who can make them structurally accurate. Mr. Hubbell is one of the few who does both.

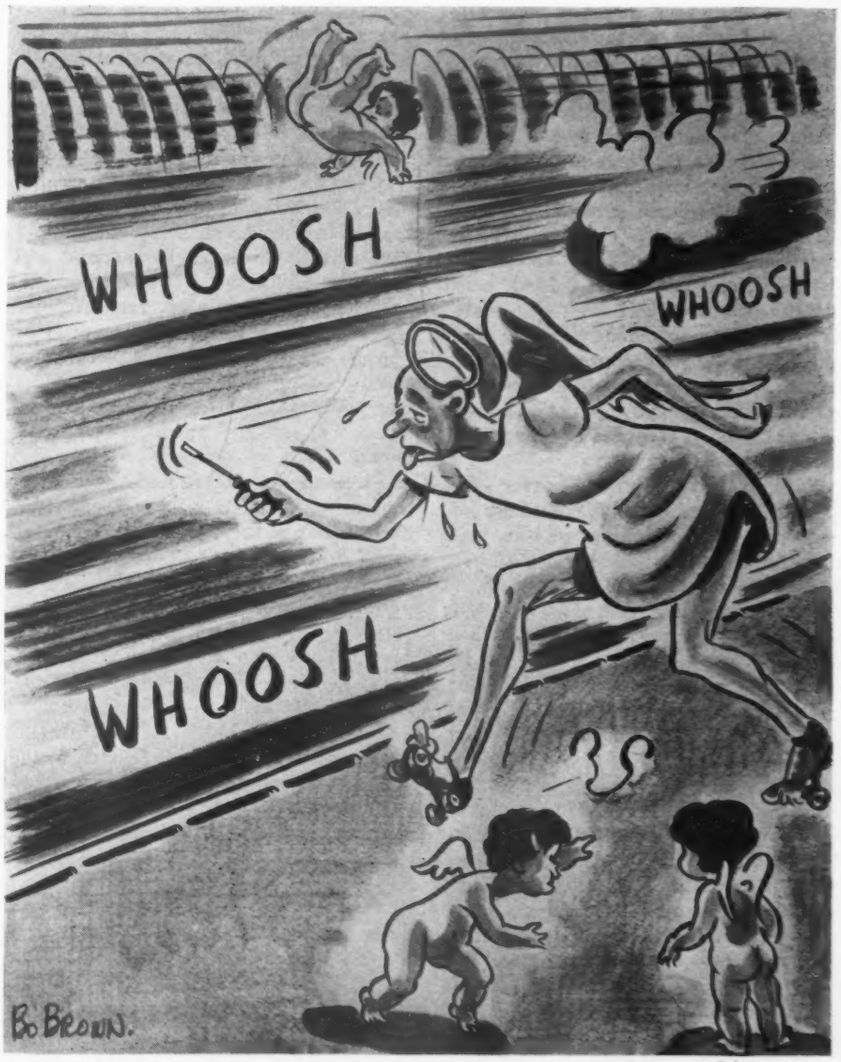
• NEXT TO THE LAST of the calendar pictures is the Ford *Tin Goose* Trimotor of the late '20's and early '30's. It is hardly fair to end the Ford with the early '30's either, as most people do, for it is still flying in several parts of the world. We have two vivid memories of the Ford plane.

One of these scenes was on the sage flat in Arizona, known to tourists as the "painted desert." We were writing some deathless literature at the time, about aviation, and a company that owned a Ford took us, and some more people, out into the painted desert to get some literary color. We landed on what passed for an airport—a longish area stripped of sage by the Indians—and quite a number of Hopis came out to look us over.

One of the onlookers was an Indian woman who looked to be about 102 years old. It soon became apparent that she was blind, for she began feeling the airplane—wheels, wings, propellers, all the while guided by an old man, who jabbered to her constantly.

After she had gone all over the ship, she made some remark and the old man laughed. We asked him what she said, and he replied, "She says it has no feathers."

• OUR ONLY REGRET is that Thompson passed up the World War decade planes. We have a good idea they did it because no American planes figured in that war, but we do hope they will get around to it some off-year in the future. We want to see some of those rotary engines that blew castor oil in our face.



"The Assembly Lines are Moving So Fast Poor Mr. Maguire Can't Keep up With 'Em!"

Aviation's Management Responsibility

By SELIG ALTSCHUL

THE ONLY ELEMENT remaining for the aircraft investor to depend upon is the integrity of management. Gone are the facilities of the past which made an appraisal of the outlook for individual companies a relatively simple matter.

The interests of national security preclude the divulging of pertinent information and uncertainty prevails at almost every turn. Military restrictions make it virtually impossible to ascertain current production rates and related data. While of interest to the stockholder, this information would be used by enemy agents as a clue to delivery schedules. Moreover, the trend of most companies is one of switching from fixed price to cost-plus-fixed-fee contracts. Here too, the exact status of these contracts and when these changes were made, are clouded in military regulations. Any possible projection of future earnings is further complicated by the voluntary reduction in prices to the government by the individual aircraft companies as a result of increased efficiency through volume production.

This has become a common practice of late and will be further accelerated by the establishment of federal price adjustment boards with their cost analysis sections to continuously review costs and profits on war contracts. In this manner, it is believed that savings made possible through mass production of war materials will be returned to the government.

No universal pattern, however, will prevail for those companies making adjustments. Those builders who are well along on models from which smooth production has removed all the "bugs," know fairly well how costs will range. Others are just beginning to hit their production stride and are still in the guessing stage as far as properly evaluating future costs are concerned. Still others are about to wind up production of models long familiar to them and are about to start on new advanced types which must submit to the ironing out of many production kinks before a smooth flow is assured. Then, there is the constant bogey of obtaining sufficient equipment and materials. Lack of adequate materials and parts at the right time, has been a frequent cause for interfering with almost every aircraft production line in the country at one stage or another.

It can be seen that even if all intricate management and production processes of an aircraft plant were revealed to an interested stockholder, it would still be almost an impossibility for him to even approximate the outlook for the year. The fact remains that company managers themselves have no way of knowing just what the year's final results will bring.

Once upon a time, an efficient operator knew what his plant capacity was, could budget his production to meet anticipated sales and assuming certain normal operating ratios would follow, could estimate profits for the period with a fair degree of accuracy.

The stress of war has changed all that, and only one thing counts now: the accelerated production of aircraft and other armaments. The means and costs take a secondary role. To add to the nightmare of production problems is the uncertainty present in the pending tax measure. While it is known that the ultimate tax bill will be severe, its final form is still in doubt.

It is true that the House Ways and Means Committee has issued its recommendations which call for a normal and surtax rate aggregating 40 percent and an excess profits tax rate of 94 percent. As presently constituted, retaining the option of using the invested capital or average earnings base along with other credits, this tax proposal is less harsh than the Treasury Department's suggestions. (AVIATION—April, 1942.) The Senate has yet to express its ideas and many changes will probably occur in conference between the House and Senate before the tax law will emerge in its finished form.

It is small wonder that the aircraft investor is confronted with utter confusion and bewilderment at every turn. It is amidst this atmosphere that aircraft equities have been continuously making new lows.

The management of the aircraft industry must be primarily devoted to the successful prosecution of the war. That is paramount. Every other consideration must be subordinated to this main effort. Stockholders must become reconciled to this view and from the broad aspects involved, their contribution in foregoing certain dividend income is a small sacrifice indeed. In any event, reconciled or not, reduced dividend payments will be the order of the day. This is foreshadowed by the statement and attendant action of one of the country's major aircraft producers—United Aircraft Corp. This company has publicly stated that earnings for the current year available for dividends on the common stock, will be at a level below those for the years 1940 and 1941. The immediate reduction of the semiannual dividend disbursement of $1 per share as contrasted to a $2 payment at this time last year, gave tangible force to this statement. It is likely that subsequent dividend disbursements of other aircraft companies will likewise be on a reduced scale.

In a number of cases, however, there has been a tendency towards expenditures which never would have been made were it not for the high taxation rates. In other words, with the rewards of increased efficiency largely absorbed by heavy taxation—and also by voluntary refunds on war contracts, managements are sometimes inclined to spend money for projects which may return some value at a future date. Many of these projects are constructive and commendable; others are not and represent squandering of both the government's and the stockholder's money. For example, increased research expenditures, usually a good tax reduction, will in the long run benefit the government, the company and the stockholders.

In recent months, many company-sponsored pension plans have been adopted in the aircraft industry. This is in keeping with the times and is constructive when the benefits are widely distributed and the cost not too onerous upon the company involved.

This pension plan can be introduced in the guise of benefiting the rank and file of an organization but in reality turn out to be a subtle device for the primary benefit of a select few.

Similarly, practices pursued by any aviation company which can stir up demands for further regulation, can exert universal harmful effects. One result can be all sorts of vindictive inquiries emanating from various legislative groups. Further, legislation may be sought which may whip the entire aircraft industry into one castigated category—such as the utilities now find themselves—and which will serve to retard future aviation progress.

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	Aircraft	Air Transport	50 Stocks
May 1, 1942...	27.12†	14.66	56
April 24, 1942..	27.95	13.75††	56
April 17, 1942..	34.11	13.44	58
April 10, 1942..	34.65	14.72	59
May 2, 1941...	33.90	18.94	66

† New low since Sept. 23, 1938
†† New low since May 19, 1939

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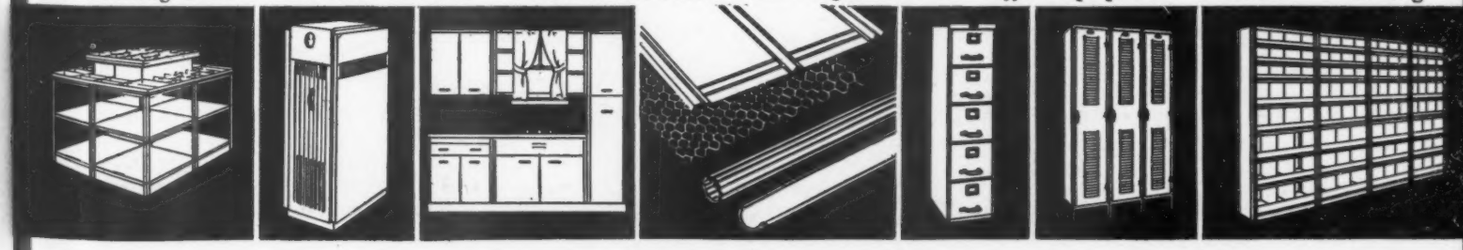

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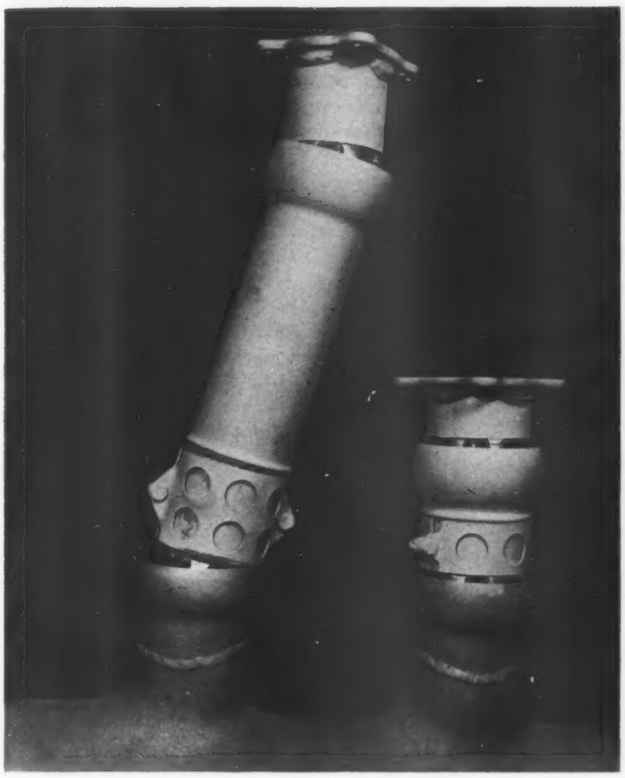


Picture indicates large amount of angular movement of ball and socket joints, making possible mounting of collector rings on airplane structure independently of engines.

Certified welders on stainless material for manifold work. Note the welder's number on part being welded making possible accurate checking of each operator's work.

Service Problems of Aircraft Engine Exhaust Systems

By
JACK C. ZIPPWALD
Manifold Service Representative, Ryan Aeronautical Co.

SERVICE PROBLEMS with any piece of accessory equipment, and the same of course is true of exhaust collectors, are materially minimized by foresight. Thus, service problems are reduced to a bare minimum when proper thought is given to the original engineering design, when production has been accurate and when the installation has been properly made.

Viewed superficially, exhaust equipment simply performs one prime duty, that of carrying away safely engine exhaust gases. Actually, it performs many other tasks to enable high performance in an airplane.

The system can be used to operate a turbo supercharger at high altitudes; it is a source of cabin heat and carburetor air heat, and some experimentation has been conducted on the use of exhaust gases for de-icing by warming the surfaces.

Because every airplane model has a different exhaust system, even though identical engines are used and the same duties are performed, service organizations have the difficult problem of stocking an excessive number of parts. To overcome this handicap, a program toward uniformity has been undertaken through the National Aireraft Standards Committee.

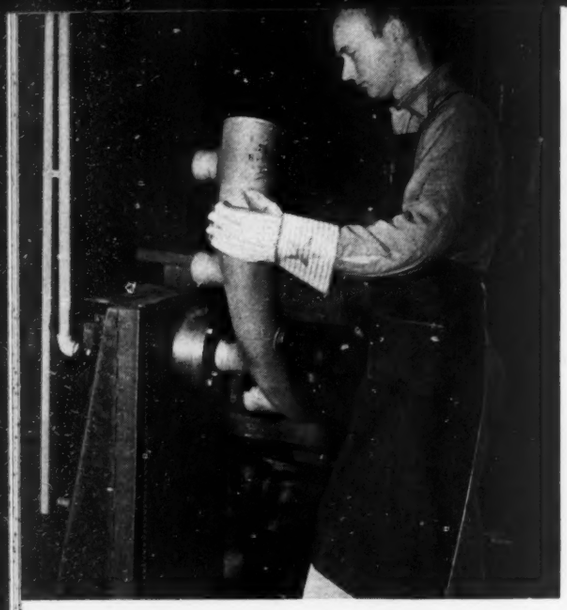
Original installation of collector rings has an important bearing on the exhaust system's service life. Correct clearances and alignment as specified by the manufacturer must be observed.

There are two general types of collectors—the slip joint type and the ball and socket type originated at and perfected by the Ryan Aeronautical Company. Each type has its particular service problems and must be taken care of separately.

Slip Joint Collectors

Analysis of the slip joint type is most feasible through a study of the various parts in sequence from the engine port to the exhaust outlet. First part to be considered is the port nipple. In some cases this part is integral with the collector ring body, but with twin row installations, at least half of the port nipples are separate parts. The port nipple supports the entire weight of the collector ring and is subject to extremely high temperature flame as well as severe strains and stresses due to engine vibration and movement.

Common service problems include



Proper sizing of sockets after welding to stacks is important to prevent freezing at joints.

Careful inspection of expansion gap and fore and aft space between front edge of ball casting and edge of stop collar is extremely important to prevent jamming of joints.

Note the detachable sockets permitting replacements without removing collector from airplane.

cracks in the metal, failure of port connecting attachments, and wear at the collector body attachment point. Cracks usually appear near the engine port and are the result of metal fatigue. These cracks can be repaired by welding, and the repair will be more satisfactory if the fatigued or cracked area is covered with a patch or doubler, after welding the cracks.

Failure of port connecting attachments usually occurs where the engine has single stud exhaust ports. Four and three bolt flange type port connections very seldom fail but do require in some cases the addition of triangular gussets where the flange is welded to the tube to prevent cracking of the tube adjacent to the flange. In the case of the single stud attachment it is necessary for the manufacturer to form a clip and weld it to the tube. These clips are subject to cracking under the hold down nut which may be avoided through addition of a doubler; cracking adjacent to the weld, which may be helped through use of a heavier gage material; and total failure by pulling a complete section out of the tube, in which case a clip with a larger base should be used. Repairs by welding, grinding and patching are at best temporary measures, second to replacement of the clip or tube with heavier material, and a possible request for redesign on future parts.

The wear or galling at the collector body attachment point is due to vibration of the collector ring. Though it is not possible to eliminate it entirely it may be reduced by keeping the entire collector properly serviced and aligned so that it will have a tendency to move as a unit instead of as individual pieces. Wear bands usually spot welded or tack welded into position, may add service life to parts. They may be removed by chiseling the spots or grinding the welds, and should be replaced by the same method as used originally. Galling may be retarded, but only temporarily, by smoothing up the galled surfaces.

Collector Collars

Consideration is next given to collars, both those used for connecting port nipples to the collector ring body and those used for connecting the collector ring sections. In some designs these parts are eliminated by telescoping the mating parts. Collars may be classified in three types, plain, single beaded, and double beaded. The plain and single beaded collars allow for slippage while the double beaded collar issued for rigid connections.

These parts are subject to wear and galling where slippage occurs, failure of bolt tubes, failure of attaching clips in the case of plain collars and failure of clamping bolts.

Worn collars should be replaced under ordinary service conditions, though in emergencies they may be patched. Wear may be kept to a minimum by keeping the collars, as well as the mating parts, properly sized to maintain proper clearances.

Bolt tubes seldom fail if properly welded, but in some cases due to misalignment or insufficient penetration of the weld, they may crack off. Such failures may be repaired by grinding the weld from the collar and welding a new bolt tube in place. The collar itself may be used as a jig by inserting the bolts and tacking the new bolt into place.

Attaching clips, used for holding straight collars in the proper position, are found to crack usually at the point where the part is bent in forming. These parts may be repaired by welding or replacement of the clip. Danger of cracking is reduced by maintaining proper fit and alignment of the collar and the collector to reduce sectional vibration. Failures after proper precautions have been taken calls for a heavier gage material or a different type of clip.

In numerous cases it is found that the bolts fail in service, due in almost every instance to improper installation. The attaching bolts are of small diameter and must not cinched up too tight or a tension failure will occur when the collar heats up and expands in operation. These bolts should be tightened very little beyond finger tightness for a safe operation. In any case collar bolts and nuts on collector rings should be replaced whenever disassembled. Where continual failure of nickel steel bolts occurs it is sometimes possible to eliminate this by using wrought iron bolts as they will take a greater elongation before failing.

Collector ring body sections are subject to cracking at the port inlets, wear at the section joints, and burning. Cracks, when they occur, are usually

Proper size of joining manifold sections must be maintained to insure proper clearances for joining collars.

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located around the port inlet. In some cases the port inlet is welded to the main body, otherwise it is formed in one piece with the body. These cracks may be repaired by welding. In cases where cracks continue to develop, a heavier gage material should be used for the port inlet so as to reduce the unit stress of the part below the fatigue limit.

Wear cannot be entirely eliminated but may be reduced by proper service and installation. Galling may be retarded by smoothing the galled surface each time the collector is serviced. Where wear bands are used they may be replaced as they wear through. Where they are not used, the section should be replaced.

Burning of collector rings seldom occurs but some collectors have "hot spots" on the aft side of the collector opposite the port inlet where the direct flame of an exhaust port may blast directly against it. Under some conditions of engine operation the temperature of the flame is high enough to burn the metal. Temporary repairs may be made by welding a patch over the damaged metal. The fair in the port should be revised to eliminate this condition.

Service problems for outlet sections are essentially the same as those for collector ring sections except that cracks sometimes appear in the body of the section due to stresses caused by a long unsupported outlet. These cracks can be welded but arrangements should be made to give additional support to the outlet either by strengthening the section or the addition of auxiliary supports. Care should be taken not to restrict the movement of the outlet, otherwise the support will do as much harm as it does good.

Intensifier tubes are often installed in collector rings or tail pipes as a source of carburetor heat or cabin heat. Pitting and wearing are their main service problems. Direct impingement of the exhaust gases on these tubes causes pitting of the metal. Amount of pitting varies with the type of fuel used. It is advisable to use fuels with low acid content to eliminate as much as possible the pitting of these parts as well as the collectors themselves. These parts cannot be repaired, especially where they are used as a source of cabin heat. They should be replaced to prevent the danger of pitting entirely through before the next service period. Wear of these parts may be reduced by proper alignment and fit.

In place of an intensifier tube some collector installations are equipped with a muff as a source of carburetor heat. This muff is merely a shroud surrounding the collector over part of its periphery, with provision for the intake of cold air and exhaust of hot air. Its service problems are not extensive. Cracks should be repaired by welding. The muff should be made to fit the collector snugly and align with the collector to reduce vibration to a minimum.

The slip joint type collector exhaust system should be removed, inspected, and serviced every engine overhaul period. The collectors should be removed and sandblasted lightly to clean the parts. Care should be taken not to sandblast parts too much as it is possible to blast a hole in the metal in a very few seconds.

The collector's parts should then be inspected for cracks and worn spots. After repairing as outlined above, the welded points should be lightly sandblasted to clean them. The parts should then be aligned and sized to proper dimensions as recommended by the manufacturer. After the repairing and service work is done, the parts should be passivated, if the material is stainless steel. Inconel does not require this process. This process improves the corrosion resistance of stainless steel and will reduce the pitting caused by corrosive exhaust gases.

After servicing, longer service life will be possible if collector is installed properly with regard to alignment and fits at the joints.

Ball and Socket Collectors

Different service problems are encountered in the ball and socket type collector. However, corrosion or pitting due to exhaust gases, and the problems relative to intensifier tubes are common to both types.

The ball and socket type collector is mounted on the engine mount or cowl well through a series of links. In this way the collector does not move with the engine but is stationary with the airplane structure, thus eliminating a major source of service trouble. The engine movement and vibration is taken up in the ball and socket joints located between the collector and the engine port.

The port nipple is practically trouble free. Due to the lack of strains imposed on this part, there is no trouble due to cracking or failure of attaching flanges or clips. The end of the port should be checked for size at each service period and re-sized if necessary, cleaned and reinstalled.

The connecting tube is straight with a spherical socket, containing a ball at one end. This part is subject to wear at the ball end, and freezing of the ball casting in the socket.

Under proper operating conditions wears is very slight, but when insufficient linear expansion is allowed for, the ball casting is pressed against the area of the socket causing wear as the engine moves and vibrates. This wear may be pre-

Slip joint type manifold: Note extremely long overhang from engine and lugs on port tubes subject to cracking out due to overhang.

Alignment of collector ring sections must be perfect before locating fittings to attach adjoining section.

Careful alignment inspection of manifolds is very important to insure proper fit on airplane.

vented by proper installation. However, once the part is worn through it is necessary to replace it.

Under some operating conditions it is found that the cast iron ball will corrode and scale and in extreme cases freeze in the socket, impeding the action of the joint. When this condition is discovered the connecting tube should be removed and the ball cleaned with a wire brush or wheel to free it up.

At the regular service period this part should be checked for size on the straight end, re-sized if necessary, cleaned and reinstalled.

Powdered graphite may be used as a lubricant to aid the action of the joint. It is not recommended that these balls be removed from the sockets without the proper tools to size the sockets. Gasolines in some cases promote this corrosion and scaling.

Care should be taken to use fuels with a low acid content. In cases where these balls continue to corrode and scale, nickel alloy cast iron balls, offering greater corrosion resistance, may be substituted.

The stop collar is not used in all installations but wherever employed, is an important part. Its purpose is to permit disassembly of the ball joints without removal of the collector ring body. When in operation it holds the ball joints in their proper position by acting as a spacer. It allows for the linear expansion of ball and socket joint assembly. Failure to allow this expansion causes rapid wear of the ball sockets.

The service problems for stop collars are nil. The collar must have the proper diameter and be free to rotate on the connecting tube when installed. The important point to check is gap existing between the collar and its head retainer. If this gap is less than that specified by the manufacturer, steps should be taken to obtain it by proper installation of the collector ring as a whole, or if warpage has taken place so this is not possible, the collar should be trimmed to at least the minimum recommended clearance.

The real socket is usually welded to the collector ring body but in some cases is fastened on by a mechanical joint. The service problems for this part are identical to those mentioned for the connecting tube.

The collector ring body itself is built in a complete ring divided usually into three sections bolted together. Service problems are few, since the part is mounted on the airplane structure. There are no slip joints or moving parts as each stamped section is welded or bolted rigidly to the next. Expansion is taken care of by mounting the collector with links which permit it to change diameter. The strains and stresses introduced through the ball joints by engine vibration and movement are extremely low.

The only problems encountered are those of pitting and burning in the region of hot spots. Pitting can be eliminated by use of proper fuels and burning would occur only as a result of faulty design. However, burning can be repaired by patching as in the case of slip joint type exhaust collector.

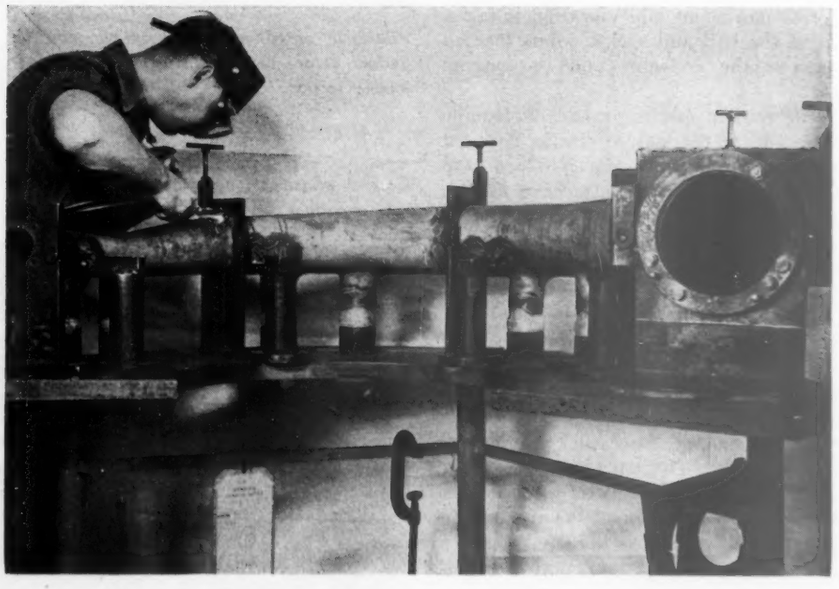
The ball and socket type exhaust collector requires very little service and the replacement of parts is low. The ball joints should be removed, checked, and cleaned if necessary at each engine overhaul period. When worn, these parts should be replaced.

The collector ring body should also be checked visually but it is not recommended that these parts be passivated as this process will destroy the ball castings.

The newer style ball and socket joint exhaust collectors have the added feature of the mechanical attachment of the rear socket which permits its easy removal. In this case the collectors may be passivated for additional corrosion resistance without endangering the ball castings. This new type collector also permits the removal and replacement of any of the ball joints that may be worn or require service in a matter of minutes. In this way regular checking and servicing may be performed without tying up the airplane.

Problems of exhaust turbo collector installations are identical to those already covered except more care must be taken in installation and fits as leakage is serious for this particular type. In slip joint type collectors, the connecting collars are sometimes packed with metallic packing which must be checked and replaced when worn. Some installations employ a special tailpipe joint, held in place with springs, to keep movement and vibration of the collector ring from the exhaust turbine. The springs should be replaced regularly to prevent the joint from collapsing as the springs are subject to failure due to the heat of the system. The ball and socket type collector has no special service problems in this particular type of installation.

Proper amount of distribution of flux is important to insure proper weld penetration and even flow of welding rod.



Heavily constructed, accurate tooling must be used to fabricate manifolds in order to hold tolerances to a minimum.

WE PRODUCE EVERY TYPE OF STEEL USED IN AMERICA'S "CANNON ON WINGS"

TRUE enough the structure of the deadly Bell Airacobra uses less steel than almost any other similar type high performance aircraft. But — where steel *is* used it is absolutely indispensable— *nothing else can take its place!*

Take, for example, the small diameter steel shaft that must, without deflection or excessive torsion, transmit nearly 1200 h.p. from behind the pilot's seat, forward to the nose of the plane. What other material could meet the high strength-volume ratio demanded here? Similar conditions hold true in other vital parts — and it is for important applications such as these that U·S·S Carilloy *Aircraft Quality* Steels are unreservedly recommended.

Here are highest quality alloy steels that have proved their special fitness to meet the strict specifications of military and commercial aircraft construction. Important expansion of our producing facilities makes it possible for us to meet your needs more completely and promptly than ever before.

U·S·S Carilloy *dependable* Alloy Steels

USS

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Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
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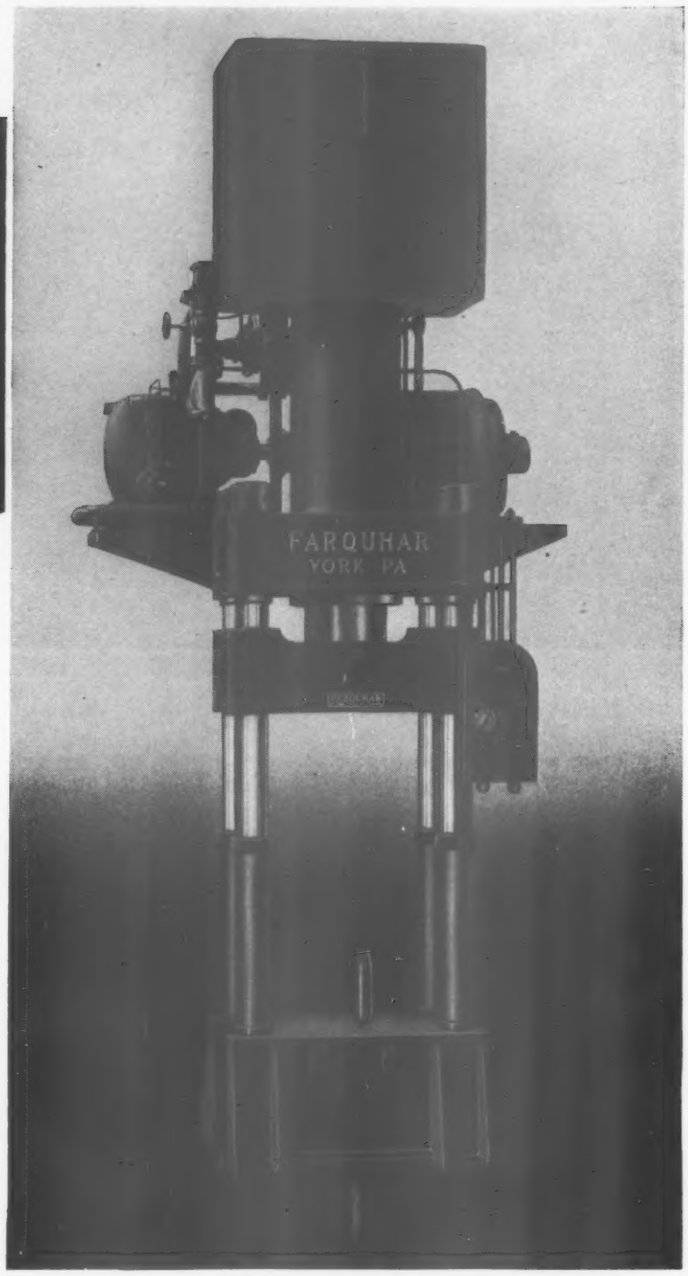
UNITED STATES STEEL

DRAFTED FOR THE DURATION



YES . . . and long after the *peace* is made, this Farquhar Hydraulic shell nosing press will be still turning out shell cases to help insure that "it shall never happen again." With 350-ton capacity and using a 150 H.P. motor, the press shown here is just one of scores of Farquhar hydraulic *draftees* which are fighting the giant battle of production . . . to keep 'em flying and to keep 'em rolling.

Farquhar is supplying high speed hydraulic presses for: smokeless powder; blocking, graining and finishing; shell and cartridge case piercing and drawing; gun and shaft straightening; forging and extrusion; blanking and forming of aircraft parts; all types of metal working. All types, sizes, all capacities . . . from 3 to 7,000 tons. Hydraulic Press Division of the A. B. Farquhar Co., Limited, 175 Duke St., York, Pa.

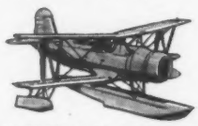
FARQUHAR Hydraulic Presses

FIRST

Since the Birth of Aviation

1926 - The Curtiss Falcon—O-1. First plane designed specifically for observation tasks and purchased in large numbers by the United States Army. Powered by D-12 engine.

1935 - The SOC-1, built for the United States Navy, shown here with land gear. Folding wings made it adaptable to limited storage space.



1937 - SOC's of this type, equipped with a single float and balancing wing tip pontoons, were placed aboard every battleship and cruiser of the United States fleet, the first model to achieve this distinction. They were launched by catapult.

1942 - The O-52, latest Army observation. High wing monoplane, excellent for vision. Slots and flaps make operation from small fields possible.

• • •

Send for YOUR copy of this fascinating 96-page history of aviation by Assen Jordanoff, author of "Your Wings", with illustrations of current fighting types. Send 10¢ to cover mailing cost: Airplane Division, Curtiss-Wright Corporation, Buffalo, New York.

"Enemy Sighted"

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION

Lloyd Hunt

Curtiss U. S. Navy SOC-1 Observation

Take Your Choice!
Large or small, straight or 90°—with one contact or a hundred contacts in one connector—for instrument circuits or 500 volt service—regardless of your needs—

CANNON PLUGS

WILL DO THE JOB

They meet any requirement for Electrical Cable Connectors in Aircraft Service

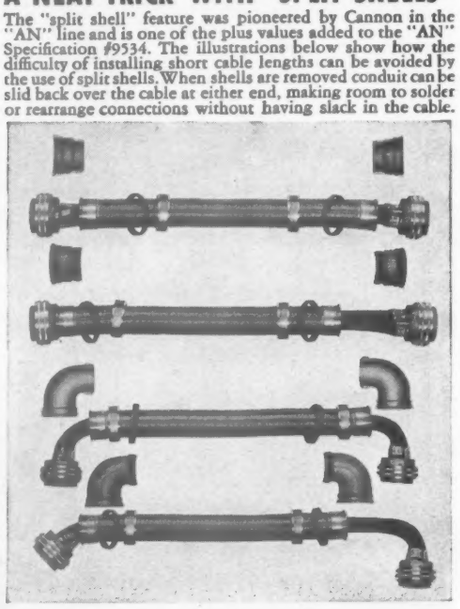
The complete line of Cannon Multi-Contact Electrical Cable Connectors offers the greatest variety of fittings for aircraft service on the market. The demands of aircraft engineers during the last ten years have resulted in the development of an almost endless variety of Cannon Connectors. Today these plugs are listed under more than 11,000 catalog numbers covering the field of Aeronautics, Sound, Geophysical Research, Television, Instrument Controls on Ships, Laboratory Panels and Commercial Power.

Having pioneered in these fields, Cannon's interpretation of the "AN" specifications has been enriched by years of experience. A number of exclusive features have been incorporated in the Cannon "AN" line which give the user many advantages in weight, ease of installation, and long, trouble-free service.

The invaluable "know-how" that comes with years of specialized experience and a rigid adherence to the highest standards have given Cannon Plugs undisputed leadership in a world market.

A NEAT TRICK WITH "SPLIT SHELLS"

The "split shell" feature was pioneered by Cannon in the "AN" line and is one of the plus values added to the "AN" Specification #9534. The illustrations below show how the difficulty of installing short cable lengths can be avoided by the use of split shells. When shells are removed conduit can be slid back over the cable at either end, making room to solder or rearrange connections without having slack in the cable.



CANNON ELECTRIC DEVELOPMENT CO.
LOS ANGELES CALIFORNIA

CANNON AGENCIES

CHICAGO: Kelburn Engineering Co., 600 W. Jackson Blvd.
CLEVELAND: Arthur H. Baier, 1957 Templehurst Drive, South Euclid, Ohio
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PHOENIX: Radio Specialties Co.
PITTSBURGH AREA: John O. Olsen, 1519 Park Blvd., Dormont, Penn.
SAN FRANCISCO AREA: W. V. Brainard, 1064 Ordway St., Berkeley
SEATTLE, WASHINGTON: James J. Backer Company, 109 Bell St.
TORONTO, ONTARIO, CANADA: L. D. Cahoon, Limited, 2271 Danforth Ave

Too Much to Tell . . .

We couldn't begin to tell you the full story of the SPARTAN School in one advertisement—or in a dozen! The scope of training, the extensive facilities, the widespread activities of this aviation school is a story that would fill a book. For here at SPARTAN we are engaged in the greatest training program in the history of any civilian aviation school . . . giving hundreds of young men the type of training that qualifies them for important aviation positions of today—and for a *real lifetime career!*

If you could visit SPARTAN you would see why it ranks as the outstanding aviation school of America. You would see 27 modern buildings located on 50 acres adjacent to Tulsa's splendid airport and providing a floor space of over ten acres.

You would see giant hangars used for storing one of the largest, and, we believe, the most modern fleets of commercial training planes maintained by any school in the United States.

You would see twenty shops and laboratories wherein young men are getting actual experience in their chosen mechanical and technical fields.

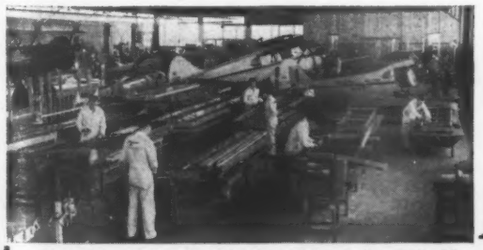
You would see SPARTAN'S 100% Approved Repair Station with its facilities for servicing the hundreds of planes now used in Civil and Military flight instruction.

You would see dozens of training planes out on the flight line . . . zooming into the sky, to land later at one of SPARTAN'S seven air fields.

Yes, and you would see light, airy classrooms . . . and clean dormitories where SPARTAN students live . . . and the cafeteria which seats 1,400 persons . . . and the barber shop, student store and soda fountain for the convenience of the students.

But this still isn't all of the SPARTAN story. There is far too much to tell . . . too many advantages to describe. If you can't visit SPARTAN, send for the *new 64-page catalog*, giving complete information.

• *{Below} Section of Spartan's Modern Airplane Shop.*



• (Above) Night view of the entrance to the new Spartan $30,000 Engineering Building, designed especially for training aeronautical and airline maintenance engineers. It is the most modern to be found at any private aviation school in the United States. Expansion of the aircraft industry has created a tremendous need for aeronautical and airline maintenance engineers. Graduate engineers are in immediate demand in our present victory program . . . and they will be in great need for post war aviation.

New 64-Page Catalog is just off the press. Mail the coupon for your personal copy. Next Semester Starts August 3.

SPARTAN

SCHOOL OF AERONAUTICS

DIVISION OF SPARTAN AIRCRAFT COMPANY

Spartan School of Aeronautics—Captain Maxwell W. Balfour, Director
Address Dept. A-62, Tulsa, Oklahoma

Send me your new Catalog, describing in detail the SPARTAN courses I have checked, also stating tuition and living expenses.

*Name*_____ *Age*_____

*Address*_____

*City*_____ *State*_____

*Previous Education*_____ (27)

CHECK COURSES YOU PREFER:

- ☐ Commercial Pilot
- ☐ Airline Pilot
- ☐ Commercial Flight Instructor
- ☐ Airline Maintenance Engineering
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- ☐ Engine Installation Mechanic
- ☐ Aircraft Assembly Mechanic
- ☐ Airline Service (A & E) Mechanic
- ☐ Airline Communications
- ☐ Private Pilot Course
- ☐ Weather Forecasting
- ☐ Instrument Technician
- ☐ Women's Instrument Tech'an

Training the Customers

A special customer service organization, the first of its kind, to train flight and service personnel of both United States and Allied Air Forces in operation and maintenance of Lockheed and Vega planes has been put in operation by the two companies.

Ground men work right in the factories under supervision of mechanics, and Air Force pilots receive training from Lockheed test pilots. Under the program, pilots and mechanics of both U. S. Army and Navy Air Forces, the RAF and Royal Australian Air Force have reached the plants for training on Lockheed and Vega bombers and *Lightning* pursuits. Also at the plant have been Brazilian Air Force personnel for operation and maintenance training on *Lodestars* purchased by their government.

In addition to the home service, Lockheed has sent men abroad, including test pilots Lewis Parker, who worked both at Singapore and Australia, and Elmer McLeod, who went to South Africa.

AAF To Factory Schools

Army Air Forces mechanics are learning repair and maintenance by first hand experience in the factories producing the planes and engines they will service in the field. Under a nation-wide program set up by the Army and selected manufacturers, maintenance personnel move from their bases right into the plants for intensive schooling by the experts who design and build the equipment.

Largest of the current groups numbers 1,000 enlisted men, taking courses prepared by Douglas Aircraft's Director of Education, C. T. Reid and Service Manager, D. S. Sprague. The men are commanded by Maj. William L. F. Pooley.

With company engineers and technicians as instructors, the AAF men see and hear how the planes are built, learn the engineering and shop procedures employed, know how equipment is installed and how to inspect and service the planes. Each day's routine includes classroom lectures and watching demonstrations on actual parts and assemblies, followed by practice service work on planes coming off the production line.

Another large group is that quartered in Seattle's Civic Auditorium, which serves as both barracks and school quarters for men being given the same type of training on Boeing *Flying Fortresses*.

Working in smaller classes are men studying equipment, such as the groups of about 20 working on superchargers at General Electric's Schenectady Works. Here too, the specialists are given four weeks' intensive training before rejoining their outfits.

The rapid expansion of the Air Forces, coupled with swift advancements in design of aircraft, is expected to result in broader application of this new training technique.

Air Hammer Test Stand

Surprising as it may seem despite the widespread use of air hammers in general industry, and most particularly within the aircraft field, no means have been available to quickly determine the operating efficiency of air driven hammers or to check the performance of such tools against predetermined standards, until the development of the Burklyn Air Hammer Test Stand according to the Burklyn Corp., 3427

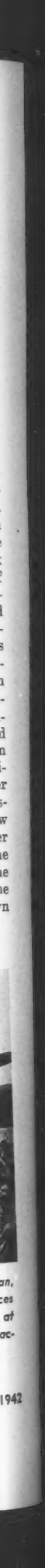
Glendale Blvd., Los Angeles, Calif. Designed primarily for use by the tool maintenance shops of plants using air hammers, although ideally suited for use by the manufacturers of such tools, the Burklyn test stand shows the three basic factors of performance—air consumption, force exerted by hammer, and blows per minute. For all three factors, the manufacturers of air hammers have established definite standards for peak performance of their tools, and with the Burklyn testing equipment these standards can be maintained by the customer.

The test stand measures 40 in. in width, 24 in. in depth at the work table level, and 58 in. in height. The work table extends across the full width of the stand and is 18 in. in depth, providing ample room for the testing and overhauling mechanic to perform repairs and adjustments on the hammers to bring them up to predetermined standards. The average air pressure used in most factories is the only external connection to the test stand, and a regulator on the instrument panel is provided so that a uniform testing pressure can be maintained in order to give uniformly accurate test comparisons. After the air is regulated to the desired pressure, it goes through an accurate flow meter which indicates, in cu. ft. per min., the volume of air consumed by the tool being tested. At the same time the force exerted by the tool and the number of blows per minute are shown

(*Turn to page 263*)

Army Air Forces mechanics learn proper sequence of supercharger assembly from General Electric expert during intensive four-week course at factory as part of nation-wide program to give enlisted maintenance and repair men thorough, first hand knowledge of planes and equipment they will care for in the field.

Factory experts service Douglas Army transport as company technician, seen under nose of plane, explains procedure to Army Air Forces enlisted men being given intensive maintenance training course at factory. Later the men, part of class of 1,000, will get actual practice on craft rolling off production line.



The POWER
THAT IS CHANGING THE EARTH

Steam power initiated our industrial civilization; the power of flight has broken down the barriers of time and distance. Improved distribution of materials and products has always preceded each new age in history. Now we look forward to the swift transport of huge cargoes in the coming Air Age—for which Wright will provide engines of evolutionary power.

WRIGHT *Aircraft Engines*

Boeing B-17E Fabricated with Boots Self-Locking Nuts

HOW BOOTS NUTS HELP BOEING WIN THE FIGHT FOR ALTITUDE

The planes that get up highest, fastest, win the air battles. And this is particularly true in high altitude bombers such as the famous Boeing Flying Fortress.

Boeing engineers, aware that lightness in weight means higher ceilings and more speed, specify the demonstrably lighter Boots Self-Locking Nut. This ingenious device insures safe, light connections that stay tight under the most severe vibration.

From the tropical, damp heat of sea level to the intense, dry cold of the sub-stratosphere, Boots Self-Locking Nut easily stands the effect occasioned by such abrupt and violent atmospheric changes.

The Boots Self-Locking Nut contains no organic material—it is all-metal and the locking force is constant. This feature makes it permanent, too. Literally, Boots Nuts "outlast the plane."

BOOTS

Self-Locking Nuts For Application In All Industries

Boots Floating Anchor Nuts are specifically designed for use where accommodation is desired for possible slight hole misalignment.

BOOTS AIRCRAFT NUT CORPORATION ★ NEW CANAAN, CONNECTICUT

By W. W. MACDONALD

Busy Airport Installs Unique Control Console

Miami's 36th Street Airport has just erected a new control tower to handle increased volume of Pan American and Eastern Air Lines traffic. In the tower is a modern traffic control console, designed and built by Communications Company, Inc., of Coral Gables. Several of the console's novel features were suggested by Pan American's chief airport controller, Jim Wynne.

The console is designed around a steel frame of welded construction. The desk top is of cigarette-proof Bakelite. Loudspeakers are conveniently located on either side of the slanting front panels. Instruments in the center section, left to right in the accompanying photograph, include an electric clock, a direct-reading wind direction indicator and a direct-reading wind velocity indicator. All of these are illuminated by a fluorescent lamp equipped with a rotatable aperture for adjusting the quantity of illumination. At the right and within easy reach of the operator are "T" pads for adjusting receiver output and loudspeaker level.

Provision is made for two banks of receivers, one bank on either side of the console. The two racks in which the receivers are mounted are on slide-rollers similar to those used in filing cabinets. A drawer for charts is located between the two receiver racks. The lower portion of the console is protected by stainless-steel kick plates.

Five Communications Company Model 82-D single-channel, fixed frequency, crystal-controlled airport receivers are used for guarding 2870 kc (PAA), 2922 kc (EAL), 3105 kc (itinerant), 3117.5 kc (scheduled airlines) and 4495 kc (Army). The receivers are mounted on standard 3½-in. high panels with photo-etched front plates. All 82-D receivers are equipped with squelch circuits which eliminate background noise in the absence of a carrier. A National Company NC-200 receiver is used for off-frequency aircraft or special flights. A Communications Company Model 126 fixed frequency receiver is used for monitoring the MM range and for WX broadcasts. A Communications Company Model 87 compression preamplifier is also used, as a crystal microphone amplifier.

The blank panel at the left was provided for later installation of interphone handsets and telephones. Provision is also made for installation of additional fixed frequency receivers, should these ever prove necessary.

Miami's 36th Street Airport traffic control console. It is rendering yeoman service to Pan American and Eastern Air Lines.

Three New Aircraft Relays

The General Electric Company has just announced three new relays designed for aircraft applications requiring light weight, suitability for severe vibration conditions and operation at high altitudes at rated current. All three operate normally at temperatures from minus 40 deg. C to plus 95 deg. C, meet Navy 200-hr. salt-spray tests for corrosion, are good for mechanical frequencies of 5 to 55 cycles per second and their contacts remain in the correct position even when the relays are subjected to a linear acceleration of 10 "G's" in any direction.

The first of the three relays is a single-pole type available in single-circuit form with one normally open contact or in a two-circuit form with one normally open and one normally closed contact. Maximum continuous current rating is 20 amp. at 12 or 24 v., and maximum make or break rating is 100 amp. The coil operates on 1.2 w. of power.

The second relay is a high-voltage type designed especially for use with radio transmitting equipment. Uses ceramic insulation and double-break contacts to permit control of circuits handling up to 1000 v., d.c. Contacts have maximum current ratings of 0.020 amp. at this voltage, or 0.100 amp. at 500 v., d.c. The coil operates on 1.2 w. Contacts are arranged for double-pole, double-throw operation.

The third type includes two and three-pole relays, available in two forms. One form has one normally open circuit per pole and the other has one normally open and one normally closed circuit per pole. Maximum continuous current rating is 8 amp. at 12 or 24 v., maximum make or break ratings 25 amp.

About Electrical Connectors

One of the most instructive booklets we've seen in recent months is a 76-page, spiral-bound, 8½x11-in. "slick" paper promotion piece just turned out by the Cannon Electric Development Company of Los Angeles to show where and how Cannon electric cable connectors may be used in aircraft.

The most striking section of the booklet is that portion of it containing photographs of 22 modern commercial and combat ships in action, a collection of shots worth having as an aid to type identification. Cannon does its subtle selling in this section by tieing in small photos of connectors used in the construction of these ships, noting the number and type of connectors used in each

(*Turn to page* 263)

"ACHIEVEMENT" by John Hammer

BRAIN CHILD—GROWN UP! . . . To the cause of an allied victory, Republic Aviation engineers have contributed a powerful aid. The swift and timely evolution of the phenomenal *P-47* THUNDERBOLT—world's biggest, toughest interceptor—from original design to large-scale production, is a worthy example of the brilliant record of American engineering genius in this war. *Republic Aviation Corp., Farmingdale, L. I., N. Y.*

REPUBLIC AVIATION

REPUBLIC AVIATION

Loading the bombs on a Hurricane bomber. The bombs are fitted with delayed action fuses to enable the plane to get clear of the explosion when bombing from low levels.

Military

FLYING TANK BUSTERS

The Axis is now pinning all of its hopes for a victory in Europe this year on its mighty tank forces. This article tells what the Allies plan to do about it.

By J. I. WADDINGTON
M.A. A.F.R.Ae. S.

AIRCRAFT which can be counted upon to pay a decisive part in shattering Germany's tank might are rolling out of Allied factories in ever-increasing numbers.

The Nazis planned that their Panzers and the Luftwaffe should provide the greatest weapon of organized destruction ever known; that they should be the spear-head of Hitler's bid for victory.

Now, with the huge American production added to the all-out British effort the Allied reply is coming into being. Allied airpower is being set to not only gain mastery of the air but to smash the tank from the field.

The Air Arm has three weapons against the tank; the dive bomber favored by the Germans, but shown to be vulnerable to strong aircraft and anti-aircraft defense; the armor-piereing shell of the cannon fighter; and the attack bomber.

The RAF are successfully developing and using both the cannon fighter and the attack fighter against German tank formations in Libya.

The tank is highly mobile and to oppose and destroy it, even greater mobility must be combined with fire power. The obvious way to get these is by using the airplane. The present cannon equipment of the Hurricane is 20 mm. calibre which is not heavy enough to pierce the main armor of any but light tanks, but they are quite adequate for flank attacks designed to shatter the suspension systems and tracks which will immobilize the tanks for later attention by artillery or bombers.

Some time ago the Bell Aircraft Company of America, showed great foresight by designing the Airacobra specifically to mount the 37 mm. cannon firing a 1½ lb. shell capable of penetrating 1½ in. of armor plate at an angle not less than 22 deg. These aircraft are known as "tank-busters" and they and their British counterparts are rolling out of the factories in ever-increasing quantities.

Essential duties of an air force are to provide information on the enemy's movements and to act as long-range and super-accurate artillery. All other operations are secondary to these.

The fighter came into being as a logical reply to the aircraft sent out by the enemy to destroy the early observation craft, and later it was called upon to act as bodyguard for bombing forces.

In its capacity as long range artillery, the Air Arm has been used in different forms and for varying technical purposes by both the Allies and the Axis. Germany regarded the airplane primarily as highly mobile support for her Army, particularly for the armored divisions, and so produced in great quantities the Junkers 87 dive bomber and the Me.

(*Turn to page 250*)

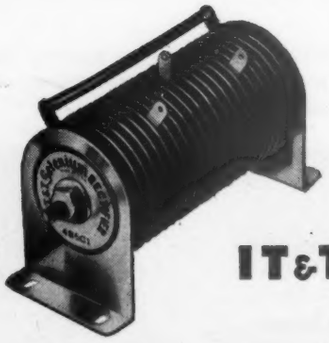
One of the weapons that the Allies plan to use in smashing Nazi Panzer divisions is the Hawker Hurricane equipped to carry bombs. This Hurri-bomber carries the punch of a dive bomber without sacrificing its capabilities as a fighter.

Serving with the Air Corps . . .

The roar of motors in the night . . . black shapes against the sky . . . *American planes are on the job!* And in the air as on the ground, wherever direct current is required from an A. C. source, I. T. & T. Selenium Rectifiers are also in the service.

Extremely compact and light in weight . . . vibration-proof and dust-proof . . . I. T. & T. Selenium Rectifiers have no moving parts to wear out or cause failure at crucial moments. Of particular value in aircraft they are unaffected by altitude and atmospheric changes and will operate over an extremely wide temperature range.

Consulting engineering services available for specific requirements. Address Department D for descriptive bulletins.



IT&T Selenium RECTIFIERS

International Telephone & Radio Manufacturing Corporation

AN IT&T ASSOCIATE

General Offices: 1000 Passaic Ave. East Newark, New Jersey

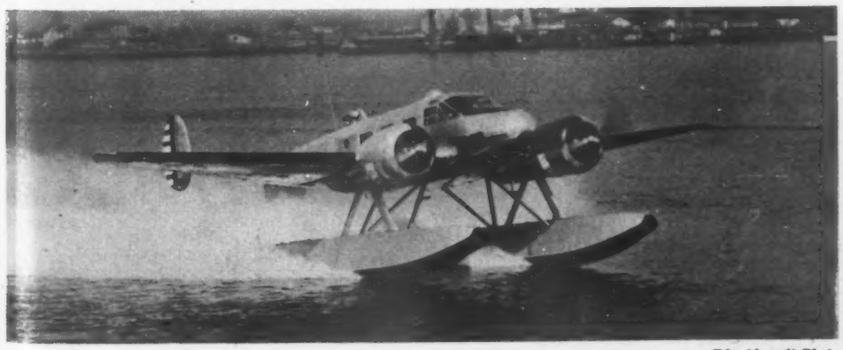
G. R. Prout, manager of GE industrial-control division and E. S. Bush, of this division, inspecting some of the devices in GE aircraft control line.

Making Combat Craft More Automatic

That increased attention is being given to making warplanes more automatic is shown in a broad line of aircraft control devices now available from the General Electric Co., recently announced by G. R. Prout, manager of GE's industrial control division. Included in the line are solenoids, relays, contactors, and pressure and limit switches some of which are also applicable to tank and other installations. A significant part of this company's industrial control engineering, production, and research facilities are being devoted to the new line. The latest advances in metals and fabrication are thus being used in the design and production of aircraft control devices to assure minimum weight and size for operation at great altitudes under wide ranges of temperature and very severe vibration conditions. General Electric's entry into the aircraft control device field supplements the company's already extensive activity in furnishing control for many other direct war applications.

UNDERGOING NAVY TESTS

Plastic plywood aircraft proponents eagerly await reports of Navy flight and destruction tests now being given the "Aeromold" model trainer shown above, recently delivered by Timm Aircraft Corp., of Los Angeles. Success of the tests may presage large-scale orders for several types of plastic-plywood craft to be used in Naval air cadet training.



Edo Aircraft Photo

THE ARMY GOES AFLOAT

Indicative of the Army's expansion to over-water operations is this Beechcraft AT-7A advanced trainer mounted on Edo model 56-7850 standard twin float gear, the first of several similar installations.

WPA Airport Work

WPA had improved facilities at 887 airports, including 533 completed projects at the end of 1941, with 76 additional projects approved for construction this year.

Current WPA work represents a large part of all wartime airport construction, almost all of which is for the Army and Navy or civilian projects certified to be of military importance.

★ ★ ★ ★ ★

UNIQUE SAFETY RECORD

A total of 2,393,745 mi. of flying under both maneuver and actual wartime conditions without an accident is the record recently hung up by the 39th and 307th Pursuit Squadrons while under command of Capt. Marvin L. McNickle, the War Department announced.

Capt. McNickle has commanded the 307th since last Feb. 1, and had commanded the 39th from Jan. 15, 1941 to Jan. 25, 1942.

★ ★ ★ ★ ★

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MAXIMUM POWER— MINIMUM WEIGHT

Constantly increased acceptance of READING "AERO" BATTERIES has demonstrated the recognition, by the Aviation Industry, of their outstanding qualities,—lightness, ruggedness of construction and exceptional Power.

Not only has the demand for READING "AERO" BATTERIES come from the Commercial field—READING is also working toward the Country's Defense, by producing batteries for the U. S. Air Force.

12-volt and 24-volt integrally-shielded types of batteries available.

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TIME IS SHORT!

50 SUBJECTS

16 MM SOUND-ON-FILM

THESE 33 IMMEDIATELY AVAILABLE

5 ON THE ENGINE LATHE

1. Rough Turning between Centers
2. Turning Work of 2 Diameters
3. Cutting a Taper With the Compound Rest and With the Taper Attachment
4. Drilling, Boring and Reaming Work Held in Chuck
5. Cutting an External National Fine Thread

5 ON THE MILLING MACHINE

1. The Milling Machine
2. Cutting Keyways
3. Straddle and Surface Milling to Close Tolerances
4. Straddle Milling
5. Plain Indexing and Cutting a Spur Gear

3 ON THE VERTICAL BORING MILL

1. Rough Facing, Turning and Drilling on a Vertical Turret Lathe
2. Rough Facing and Boring and Turning a Shoulder on a Vertical Turret Lathe
3. Facing, Turning, Boring, Grooving, Chamfering on a Vertical Turret Lathe Using 2 Heads

5 ON PRECISION MEASURING

1. The Steel Rule
2. The Micrometer
3. Fixed Gages
4. Vernier Scale
5. Height Gages and Standard Indicators

3 ON THE SHAPER

1. Cutting a Keyway on End of a Finished Shaft
2. Machining a Rectangular Cast Iron Block
3. Machining a Tool Steel V Block

2 ON THE RADIAL DRILL

1. Drilling and Tapping a Cast Steel Valve Body
2. Drilling and Spot Facing a Cast Iron Valve Body

10 SUBJECTS ON SHIPBUILDING!

1. Preparing and setting a keel block and bottom cradle
2. Inner bottom section: Sub-assembly of a closed floor, Sub-assembly of a solid floor
3. Inner bottom section: Setting up and fitting floor
4. Deck Girder: Sub-assembly
5. Side Frame: Sub-assembly of a web frame
6. Girders: Setting transverse web frame and a horning girder
7. Bulkhead: Laying off the boundary and stiffeners on a transverse water-tight bulkhead
8. Bulkhead: Laying off and fitting a center line stiffener
9. Bulkhead: Setting a transverse, water-tight bulkhead and hull
10. Deck Plates: Regulating and setting

17 OTHER SUBJECTS ON MACHINE SHOP WORK WILL BE RELEASED SOON!

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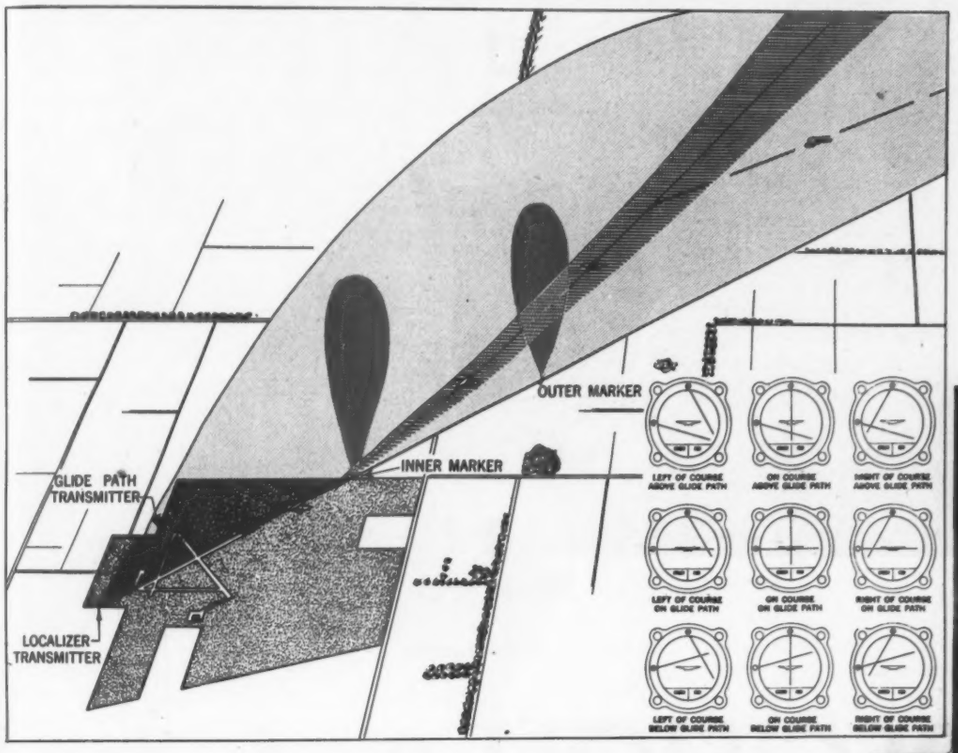
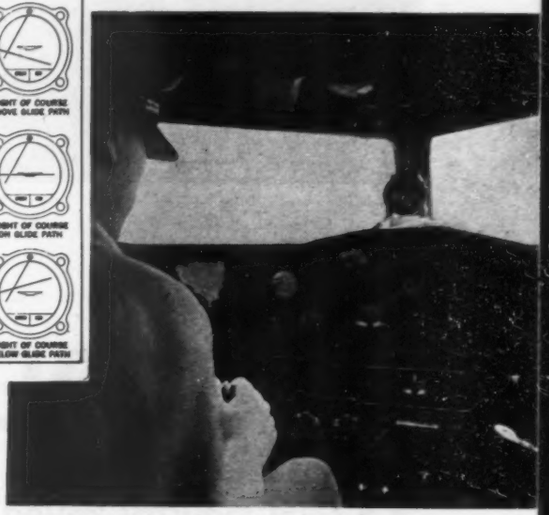
Made with 30", 36", 48" and even larger throat capacities if desired, these machines are identical in general construction with our Model M-24 with 24" throat capacity, the machine which has been termed the most highly developed die saw on the market. And like the M-24 they will show an average saving of 70% of the time required by other methods in making inside and outside cuts on dies, tools, jigs, templates, fixtures and dozens of similar operations. Whatever your requirements may be, write NOW for the Tannewitz Di-Saw Bulletin. You'll find it contains the machine that's ideally suited to your needs.

THE TANNEWITZ WORKS, GRAND RAPIDS, MICH.

The cross-pointer instrument tells the pilot when he is on a course leading to the centerline of the runway, and when he is descending toward the runway at the proper angle. Vertical needle swings to right or left as plane leaves proper position. Note that the little plane on the instrument gives the position of the real plane. Thus, if the vertical needle is over to the right, the plane is to the left of the proper course, and the real plane is steered to the right until the vertical needle is exactly vertical. Similarly, the horizontal needle indicates the position of the real plane with relation to the little plane on the instrument. When these two lines cross in the center of the instrument, the pilot is on the correct course, and is descending to the runway at the proper pre-determined angle. Marker beacons flash lights on the panel, and/or buzz in the pilot's earphones, giving him indication of his progress.


OUTER MARKER
INNER MARKER
GLIDE PATH TRANSMITTER
LOCALIZER TRANSMITTER
LEFT OF COURSE ABOVE GLIDE PATH
ON COURSE ABOVE GLIDE PATH
RIGHT OF COURSE ABOVE GLIDE PATH
LEFT OF COURSE ON GLIDE PATH
ON COURSE ON GLIDE PATH
RIGHT OF COURSE ON GLIDE PATH
LEFT OF COURSE BELOW GLIDE PATH
ON COURSE BELOW GLIDE PATH
RIGHT OF COURSE BELOW GLIDE PATH

Here the essential instrument landing instruments are grouped for convenient reading by the pilot. Within white line, from left to right, sensitive altimeter; cross-pointer instrument; rate of climb and descent indicator; turn and bank indicator and tachometer. To left of group, under clock are lights which are turned on as the plane passes through the marker beacons.



Instrument Landing Systems Will Aid War Effort

War doesn't stop for the weather—if you can fly zero-zero. Airlines and the air forces in collaboration with CAA and commercial firms have adopted standard equipment and procedure.

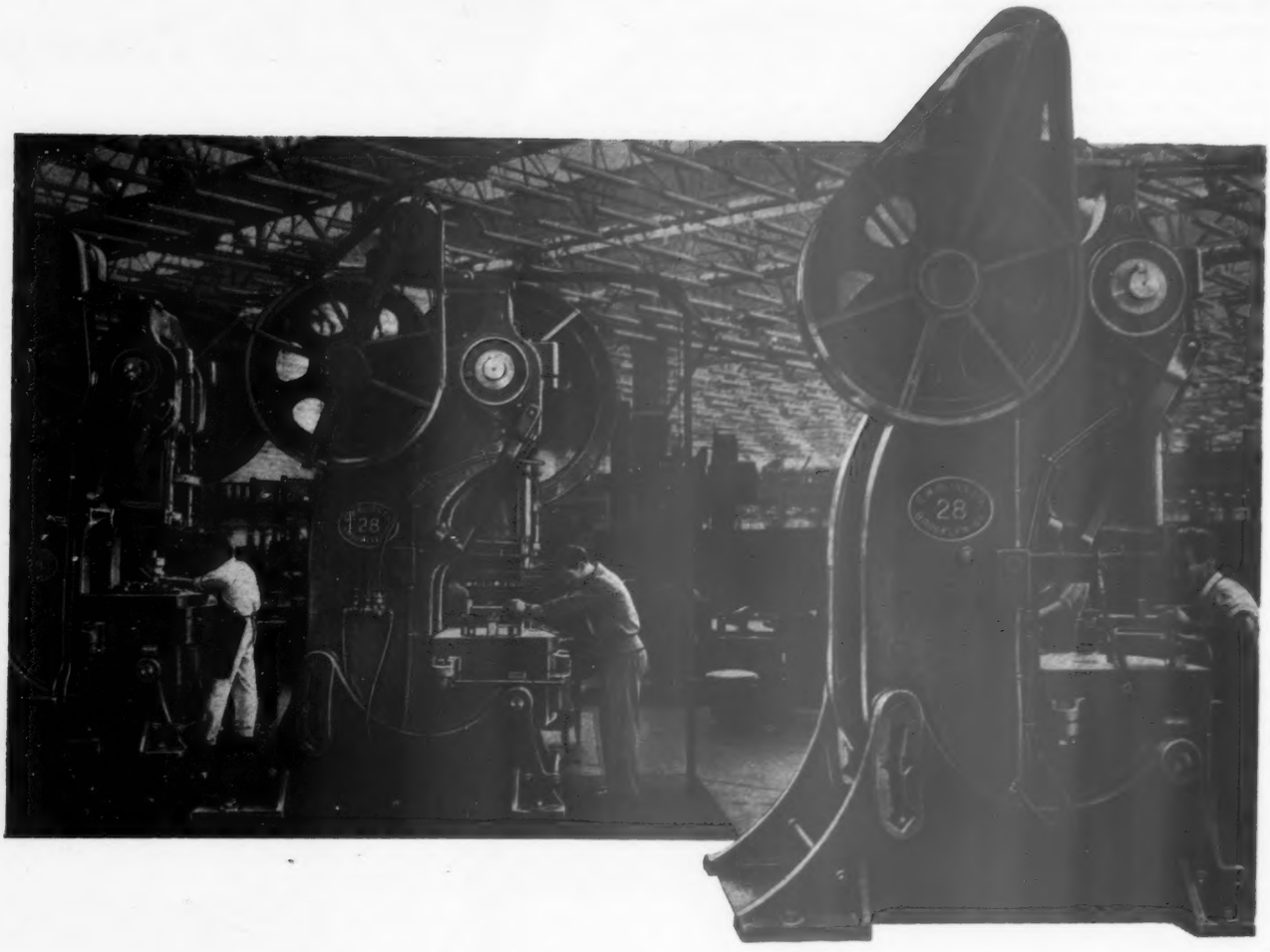
By A. C. PREIL,
Chief, Signals Division, Civil Aeronautics Authority

IN A WAY, THE WAR and its priorities and its appetite for materials and manhours and plant capacity is slowing development of instrument landing. But in other ways, partly because the military itself wants this aid to flight, war is speeding instrument landing.

The important achievement, since the basic problems of instrument landing themselves were licked, is complete agreement between civil and military aviation on a standard combination of equipment and procedure. History of the baker's dozen systems, and final settlement on one for the airways when the President intervened, need not be repeated here. Now, the Army and CAA and the operators and manufacturers, are all on the same team. This unity turns a tug of war into a drive.

We probably shall not have instrument landing throughout our scheduled transport system till some time after peace is declared, depending on when that happens. But we shall certainly have the job in the bag.

Three instrument installations are being commissioned on the airway system this spring: Washington, Oakland, and Atlanta, and the original experimental



Peak PRECISION *Production*

WITH industry keyed to the war effort, and government constantly setting up new production goals, the need for precision equipment becomes more and more acute. Five American plants with a background of 85 years' machinery building experience enable Bliss to play a prominent part in supplying Uncle Sam's industries with metal working equipment.

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station, commissioned at Indianapolis in 1939 makes four. The Indianapolis plant, incidentally, has trained over 100 pilots to sit down on terra firma with eyes and ears on instruments. Most of these men are on United Air Lines.

Not much can be told of what the Army is doing, but we can explain a little about how. This country has no monopoly on the radio pattern and the means to trace it by airplane. Germany's Luftwaffe is using radio landing equipment, and the Nazis know that we and Britain are using it. Basic principles are the same everywhere.

Every air combat task commander knows the serious need for zero-zero instruments and the skill to use them. There is no secret about that. You can't wait for a fair and warmer report before hitting the enemy. The weather closes down while your planes are out. They come back, find themselves unable to get down and you lose them.

Censored information shows some appalling losses of planes deserted by their crews above overcast. In some cases the losses were greater in a few hours than the enemy could have inflicted in weeks. So the need is great and the remedy is at hand.

Before going further, suppress your desire to ask about the Navy. Navy radio control problems are highly specialized, whereas the Army's practice is much like that of the civil airways, which is pretty well known. So the Navy has nothing to say.

Army Air Forces has asked the Civil Aeronautics Administration to set up 50 instrument landing systems. Most of these installations will be on civil airports now used by the airlines, many of which fields are also used by the Army. Each installation will consist of a localizer, an inner and an outer marker, each marker station having both a UHF and a low frequency marker ("locator").

There are reasons, of course why Army is not asking for glide path equipment. The Army intends to have its own glide path transmitters in a reasonably short time. Army will use a "very high indeed" frequency, as one man expressed it.

The localizer beam and the two markers can be used temporarily to great advantage, without the glide beam.

Another reason Army is waiting on glide beams is that a new type is recommended and contracts are outstanding for both the new and the old. The old system is the equipotential or single-pattern glide path. It slants up into the air against the direction of approach, and the airplane follows in along its under side, in a slight curve. This projection is thrown off if absolute sensitivity is not maintained. If the potential or output is increased, it lowers the path toward the ground.

The recommended new transmitter, not yet in use, projects two patterns which overlap, just as they do from the regular airway range transmitter, except they are turned up on edge, in a vertical plane, instead of horizontal. The glide path is the line of overlap of the two patterns and it is a straight line, whereas the equipotential pattern is curved. The transmitter projecting the overlapping pattern can vary in sensitivity, and can vary its output, without changing the path.

Presumably the Army and CAA both will use the overlapping pattern system as soon as it can be produced in sufficient quantity.

Installations Under Way

Looking again at the airline picture, the CAA is now making installations at Washington and Oakland using equipment previously set up at the Indianapolis airport. In addition, International Telephone Development is under contract with the CAA for six complete installations as well as ten sets of complete equipment, the installation of which will be made by the CAA.

There was an approved list of cities to receive the first ten but it is invalidated now, because of military interests. This is not to say that some or most of the ten cities will not be chosen as locations, perhaps all of them.

The airlines, having whipped the difficult problems of developing proper receivers and antennas for instrument landing, have also succeeded in getting priority ratings which will permit early delivery of the necessary plane equipment. This means complete plane equipment consisting of glide path receivers, localizer receivers, cross pointer instruments and antennas, will be available.

The determining factor in starting training of airline pilots is the delivery date of this essential receiving equipment for the planes. The most distant delivery date is that for the glide path receivers, and this is set for early in June. The localizer receivers may be available for May 15 and instruments and antennas shortly after that.

By early in June regular instructions of airline pilots in landing by instrument will be started. Thereafter, the date of starting actual landing by instruments on regular schedule will be a matter of ruling by the CAA in collaboration with the airlines and pilots concerned.

The airlines have on order 163 flight path receivers. Delivery of these should begin by June. A "super" localizer receiver, a 30-channel, push-button tuning receiver which will receive the localizer signals, radio range signals and airport traffic control signals, has been granted its Approved Type Certificate by the CAA, and the material is on hand for manufacture of 225 of them. The first of these should be in airline workshops by May 15.

The antenna for the localizer receiver has been under development in the laboratory of United Air Lines, and contracts for manufacture are now being signed. Since this is a small piece of equipment, the matter of priorities on materials is not expected to present an obstacle, inasmuch as the antenna is inseparable from the localizer receiver, and the Aeronautical Radio Officials have obtained an excellent rating for the receiver.

An equally good priority rating has been obtained for manufacture of the cross-pointer instruments which are the essential cockpit elements of the system.

Complications have frequently arisen to delay progress. One of these had to do with the export of our basic ideas and their development in Europe. As soon as the German scientists who visited the Bureau of Standards and examined our early development had adapted them to the frequencies available in Europe critics began to complain how far ahead of us Europe was in instrument landing. Actually the European system has always been used mainly as an approach system.

Later, other methods of instrument landing appeared in this country, and various airlines and designers urged them on the government for general use. None of these, however, received unanimous approval of the airlines, and without that, could not be adopted for use on the whole airway system.

The Technical Development Division of the CAA has collaborated with all interested parties in the development, and has brought the present system to practical application in its work at the Experimental Station of the CAA at Indianapolis.

The present approach system involves coming in on the regular airway range, passing one or more markers and letting down with the aid of watch, altimeter, compass and quadrant signals, following a predetermined procedure that is different for each airport. This is done only if there is a minimum ceiling of, usually, about 400 ft. Bringing the instrument landing system into use will be subject to the orders of CAA, which will gradually lower the ceiling. Progress will be limited by the performance of the least-capable pilots.

Of course there is no such thing as absolute zero-zero. The co-pilot can see the runway lights even in the thickest stuff, during the last 50 to 100 ft. of descent.

EVER LIGHT A TURRET LATHE WITH MATCHES?

That's what Walter Rabel had to do before they put in G-E Fluorescent Lighting!

WALTER RABEL turns gear blanks on a turret lathe in one of the nation's vitally important subcontract shops. Where he works they make many types of gears—the largest for a big Diesel engine is 19 inches across; the smallest is for an airplane windshield wiper.

BEFORE G-E FLUORESCENT LIGHTING was installed he had to light matches—even in the daytime—to see into the bore to make sure that the cutting tool was properly adjusted. Now with fluorescent lighting, the light is so well distributed that he can see the operation much more easily and quickly.

BECAUSE GEAR MAKING is a precise job done to tolerances as close as one ten-thousandth of an inch, the slightest flaw or imperfection in the teeth of a gear means a reject. With the former lighting considerable time was lost taking the micrometer to the window for reading. Now this is unnecessary.

IF YOUR SHOP NEEDS better lighting for war work and you have a suitable WPB priority rating, ask your G-E lamp supplier about installing fluorescent lighting in certified fixtures with G-E MAZDA F (fluorescent) lamps . . . the kind that are *made to stay brighter longer* and that provide cool, efficient "indoor daylight" 24 hours a day.

IF YOU CAN'T INSTALL better lighting now, you can make your present lighting do a better job by doing such things as:

1 Use soap and water . . . on a *regular* cleaning schedule.

2 Right size bulbs in present fixtures.

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6 Frequent light meter checks on maintenance.

For further details, see your G-E lamp supplier.

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GENERAL ELECTRIC

Kansas City's great municipal air terminal is rated as one of the most convenient metropolitan airports in the United States.

Kansas City's Airport System

With well-founded confidence in aviation's future, this municipality's long-range airport program proposes five big municipal airports encircling the city.

By WILSON W. BROWN, *Assistant Aviation Commissioner, Kansas City, Mo.*

KANSAS CITY'S leaders are at work building a great system of ultra-modern airports in fulfillment of what they believe to be an important war effort responsibility.

The city's elaborate long-range airport program, in fact, proposes the construction of five big municipal airports encircling the city . . . and this in the face of the fact that Kansas City already is a top rank aviation center!

The first of this system of "air harbors" to facilitate new aircraft plants, airline and air freight routes and many other aviation activities was put under way this month, when Kansas City voters flocked to the polls on March 10 to vote a million dollars in city bonds for this first additional municipal airport.

Less than two weeks later, dust already was rising on a vast 1038 acre upland site south of the city as workers started a project which soon will see the completion of an airport which eventually may be another four million dollar Kansas City investment in the future of aviation.

Seven hundred thousand dollars of the million dollar airport fund has been made immediately available for contract construction of wide concrete runways up to 7,000 ft. long, access roads and other improvements.

President Roosevelt has specifically designated the new airport as an esential war project and has alloted an additional $540,000 in federal funds for grading and drainage of the airport site.

The big airport bonds fund also has been offered in part to the federal government. to permit additional federal participation in the construction job.

The visions of the city's aviation boosters, now taking concrete form in this first new auxiliary airport, first began to assume definite shape in the peaceful days of early 1939.

Air transportation was growing by leaps and bounds. Private fliers, yet without benefit of Civilian Pilot Training, were taking new wings by the hundreds in the Kansas City area. Farsighted airline executives of Mid-Continent and TWA, citizens of Kansas City, began to talk meaningfully about the coming of air freight and all first class mail by air.

Fully in tune with these significant signs of the future, the Aviation Committee of the Kansas City Chamber of Commerce, composed of 56 members representing 35 aviation industries and many other businesses, quietly launched a pretentious engineering survey of possible airport sites in the metropolitan area.

With the assistance of SAA and city engineers, the committee made scores of aerial photographs of every available practical site immediately adjacent to the city and conducted detailed surveys of the surface terrain, weather conditions, and highway and rail access facilities.

Subsequently, the committee presented to the city council detailed information on ten possible airport sites and proposed that at least five additional airports would be needed to meet the rapidly growing requirements of aviation.

Within a short time, it became apparent that the war had imposed the necessity for a vastly accelerated pace toward the inauguration of the projected additional airport building program.

Construction at Kansas City's second municipal airport is in progress. Here is an artist's conception of it when in full operation.

On March 21, 1941, a subcommittee on additional airports urged the city administration to begin construction as soon as possible on Greater Kansas City's first new airport, and proposed a site near Grandview, Mo., just south of the city limits.

City engineers immediately launched more specific engineering surveys of this site and by late summer the city council had purchased 751 acres with funds which had been saved out of the general operations of an efficient city government. Since the bonds election, plans have been made to purchase an additional 287 acres to bring the total acreage of the new airport to 1,038 acres.

An application for a large federal project for drainage and grading at the new field was submitted, using ownership of the site as a sponsors contribution. This project was finally approved on February 28, 1942 and work already is underway.

To furnish funds for further acquisition of lands and to build concrete runways, access roads, lighting, etc., a million dollar bonds issue was proposed, and the Chamber of Commerce Aviation Committee was given the task of securing its approval at the polls in the regular city elections, March 10.

The city's aviation enthusiasts turned out en masse to make numerous radio talks on broadcasts time donated by helpful radio stations; to appear before civic and political meetings; and to do general yeoman service in a fast-stepping campaign. When the ballots all had been counted, it was evident that voters had returned a four to one majority in favor of the million dollar bonds issue, just five days before the nation's heaviest income taxes came due.

But, practical Kansas Citians look upon their new municipal airport as anything but financial folly.

Again, with a weather eye to the future, the airport's planners laid out a field which is uniquely an "industrial airport."

Two trunk line railways border the new airport on two sides and a three-lane highway connects the airport with downtown Kansas City. Aircraft plants which may be located at the new airport will be able to take full advantage of rail freight service, as well as rail passenger commuter service to residential and business districts for plant workers.

A large sewage disposal plant, water and power facilities and additional access roads are included in the plans.

The city's visionary airport builders have used their two other "industrial" airports as a pattern on which to plan their third municipal airport.

Kansas City Municipal Airport, known far and wide as the air passenger terminal which is but 15 city blocks from the center of the business district, is in the heart of the important north Kansas City industrial district, serviced by four trunk line railroads and the water commerce facilities of the Missouri river.

Two major airlines, Mid-Continent and Transcontinental & Western Air, make their general headquarters on this field.

Fairfax Airport, now undergoing a $2,500,000 Army Air Corps expansion program, is used as a flight testing and fly-away delivery base for the huge new North American Aviation bomber assembly plant, for the Rearwin Aircraft Company, and for the new Interstate Aircraft and Engineering Company. The field also is used as a Naval and Marine Reserve Air Training base and an Army Reserve Air base.

This airport also is graced by several new concrete runways more than 6,000 ft. long, and is located in the center of the important Kansas City, Kan. Fairfax industrial district, developed by the Union Pacific Railroad only a short way across the river from the Kansas City Municipal Airport.

Only a few miles from downtown Kansas City, near Gardner, Kan., the U. S. Navy is building a huge Naval Air Training and Air Transport base which is expected to be completed soon.

The main Naval airport will boast 5,000 concrete runways 250 ft. wide and will have complete officer and enlisted personnel quarters, hangars and operating facilities. Surrounding the main airport will be ten smaller practice and emergency training fields. Approximately 3,500 officers and men will be billeted at the base.

Supplementing the city's big municipal and military airports, fixed base operators have built three well-improved private fields, to accommodate CPTP flight training and several hundred private fliers in the city area.

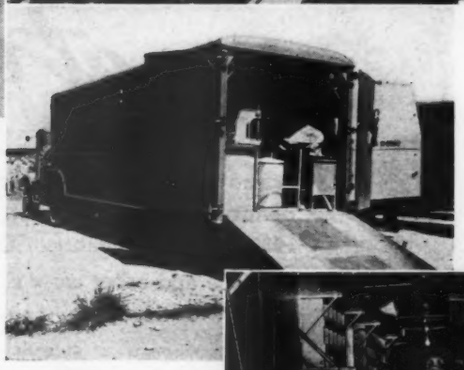
But, equally as important to the establishment of new aircraft industry as its vast present and building airport facilities are Kansas City's tremendous reservoirs of available labor, housing, transportation and utilities.

In March, 1942, there were more than 72,000 persons in the Greater Kansas City area registered with the federal employment service as immediately available for war production jobs. All of these were housed, and, therefore, do not constitute a housing problem such as is

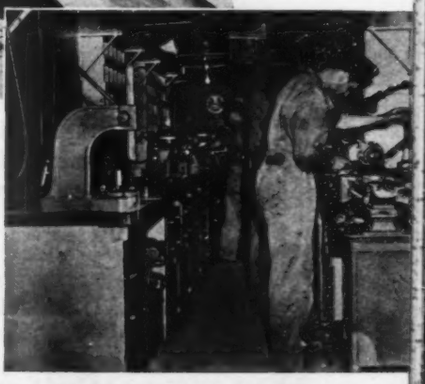
(*Turn to page 250*)

DoAll KEEPS 'EM IN THE SKIES AT UNITED AIR LINES

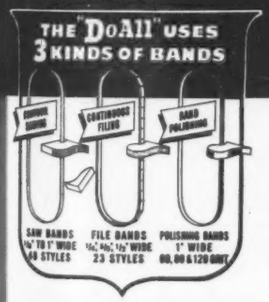
One of the DoAlls at work in the shops of a United Airline Maintenance Base.



AND IN U. S. FIELD SERVICE



One of the fleet of portable machine shops of the U. S. Air Corps for servicing combat planes in the field. Damaged planes can be reconstructed and repaired right on the spot. Each unit contains a DoAll Contour Machine as part of its equipment.



● Aiding in the big job of airline maintenance and, therefore, in the vital role which air transportation is playing today in the war effort, are DoAll Contour Machines, such as installed at United Air Lines' Maintenance Bases.

United Mainliners are routed to the base after every 725 hours of flight to become "new" planes for their job of carrying passengers, mail and express between key cities, production centers, and military establishments of the nation.

A WEEK'S WORK IN A DAY! A DAY'S WORK IN AN HOUR!! AN HOUR'S WORK IN 10 MINUTES!!!

Those are the records of DoAlls in factories everywhere. Whether you make plane parts, assemble planes or do repair work, you'll find the DoAll the fastest precision method to remove metal. Nothing compares with it when it comes to internal and external cutting of any metal or alloy, especially aluminum, magnesium, masonite, synthane, plymetal, copper, stainless steel, etc.

Let a factory trained man call with a DoAll and show you how it can cut corners and save time and money in your own plant.

NEW—Send for helpful book "DoAll on Production" for a bird's-eye view of real accomplishment.

THE EXACT SIZE FOR YOUR JOB

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Associated with the DoAll Company, Des Plaines, Illinois,
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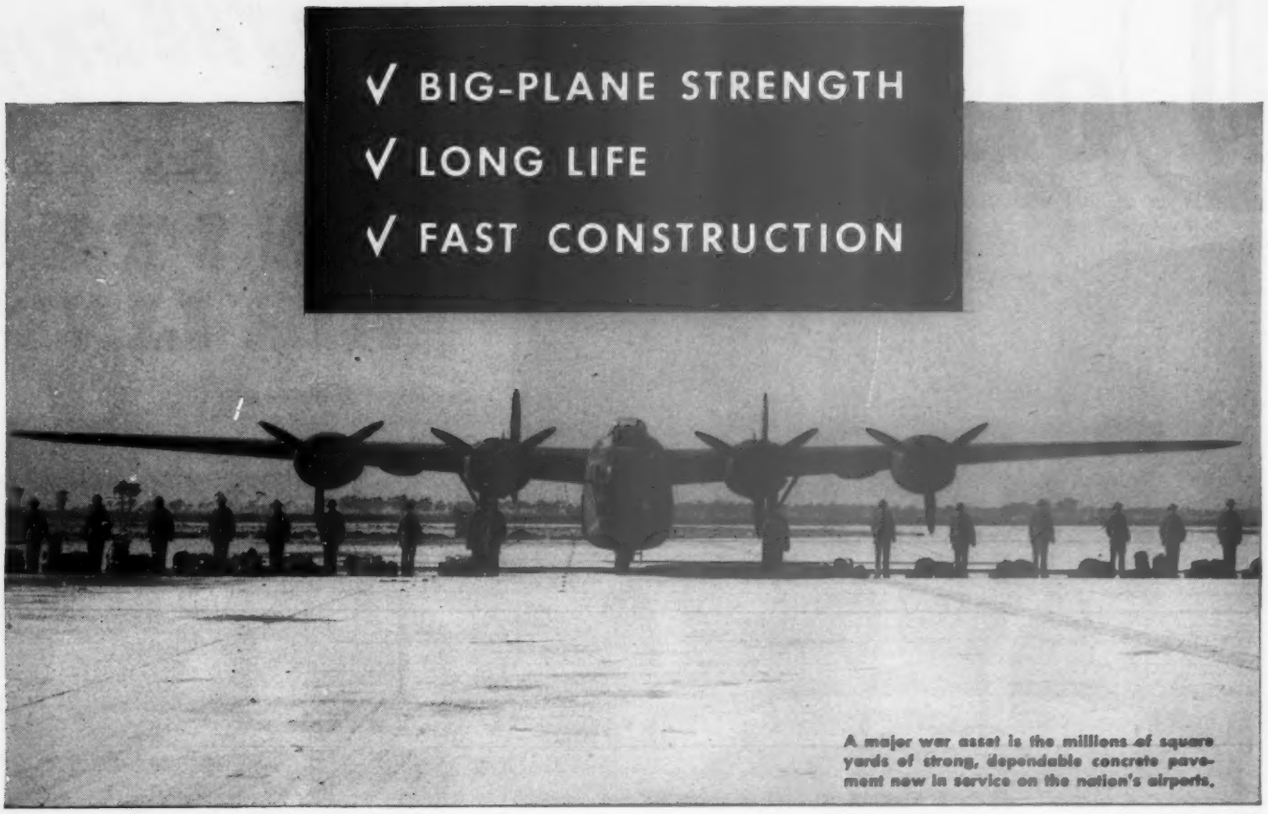

A major war asset is the millions of square yards of strong, dependable concrete pavement now in service on the nation's airports.

U. S. Army Air Corps photo

CONCRETE meets these runway "musts" —at lowest cost

Concrete is playing a vital part in major airport construction today because it has no equal for safe, economical, uninterrupted service. As proof, look at Floyd Bennett, first concrete built in 1929... Grand Central, 1928... Lunken Field, 1932... Wayne County, 1929... Indianapolis, 1930... Barksdale Field, 1934.

These and other early concrete surfaces have carried heavier and heavier traffic with negligible maintenance and repairs.

CONCRETE AIDS ACCURATE DESIGN
Proved formulas assure safe, accurate concrete pavement designs for wheel loads up to 120,000 pounds and more.

SPEED ON THE JOB
500,000 square yards of concrete airport pavement can be completed in 30 paving days. There's minimum weather delay.

LESS MATERIAL TRANSPORTATION
Concrete provides strength for heavy duty with smallest quantities of materials, hence with minimum burden on transportation.

LOWEST FIRST COST AND MAINTENANCE
Heavy duty concrete runways cost less to build than other surfaces of equal load capacity. Their low upkeep conserves wartime labor and materials, reduces the final cost.

The assistance of our technical staff is available to designers and builders of airports and other war construction.

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Dept. 6-41, 33 W. Grand Ave., Chicago, Ill.
A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

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tesy Wright Aeronautical Corp.

Hard-Hitting Wrenches for Victory!

"LET'S GO! U.S.A." "KEEP 'EM FLYING!"

Speed with power and light weight with toughness—that's the kind of service all-out war effort demands of wrenches . . . and *gets* in Williams'. Our armed forces master complicated maintenance with them. In aircraft factories, they step up many operations to make record-breaking production. In leading aviation schools, they are used to develop better mechanics, faster. In fact, wherever vital-to-victory air superiority is in the making, "Superrenches" and "Supersockets" are accepted as the maximum of critical performance.

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WRITE US FOR THE NAME OF YOUR NEAREST AIRWING DISTRIBUTOR

Merlin "Twenty"

Increased performance and slight increase in the overall length are the principal differences in new Rolls-Royce model which is under construction in this country

DETAILS of the latest Rolls-Royce *Merlin XX* model, of which Packard Motor Car Company is to build 9,000—one-third for the Army Air Forces, and two-thirds for England—have been reported by our British contemporary, *The Aeroplane*. The American-built engine is similar in design to that in production in Britain except that in this country the model is built with a two-piece cylinder block.

As reported by *The Aeroplane*, the *Merlin XX* differs from earlier types chiefly in its two-speed supercharger, which makes it slightly longer. The rated output is 1,260 hp. at 12,250 ft., which represents an increase of power of 16.3 percent over the previous *Merlin X* model at an altitude 18.3 percent higher, while the weight increase is 8.5 percent. The dry weight of the engine is 1,450 lb.

The gain in power is said to be a result of better performance from the supercharger and a longer carburetor.

Comprising 11,000 separate parts, including 4,500 different varieties of parts, the *Merlin XX*, like others of the series, is a 12-cylinder upright 60 deg. Vee-type arranged as a right-hand tractor. Each cylinder block is a single aluminum casting, comprising the head and coolant jacket. Wet cylinder liners in high quality steel are inserted into it and are provided with suitable joints at top and bottom to prevent leakage of the coolant into the cylinder, or gas leakage from cylinders into coolant system. Fourteen long studs, which extend to the top of the block, attach each cylinder block assembly to the crankcase.

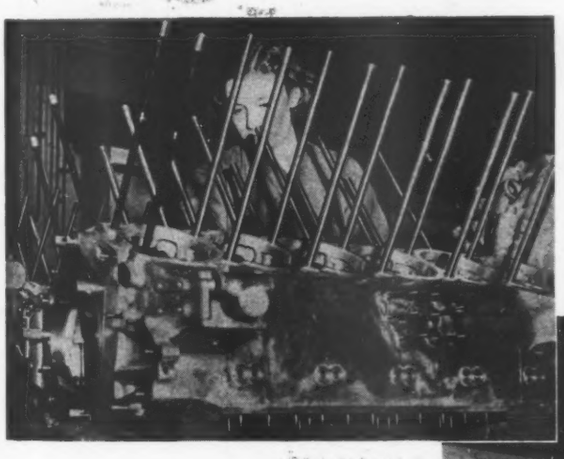
Two inlet and two exhaust valves, operated through rockers, are provided each cylinder. All valves are parallel with the center line of the block and are fitted with two concentric coil return springs per valve. One camshaft is used for each cylinder block and is carried in seven forged aluminum bearing pedestals mounted on the top face of the cylinder casting. The camshafts are driven through bevel gearing by two inclined shafts, one at the rear of each.

The valve seatings are made from special heat-resisting steel, and screwed into the aluminum cylinder head. The valve guides, in cast iron for the inlet valves and phosphor-bronze for the exhaust valves, have taper shanks and are pressed into suitably machined holes in the cylinder casting.

Bolted at the front end to the top half crankcase, which is a rigid aluminum casting, is another aluminum casting which houses the propeller reduction gearing and its shafts and bearings. The lower half crankcase contains the oil pumps and filters and is a shallow casting of aluminum. At the rear end is another casting, known as the wheelcase, which carries gearings, bearings and driving shafts for the supercharger, magnetos, starter, dynamo, camshafts, coolant and fuel pumps.

A balanced hollow crankshaft is used, made from a one-piece steel forging, having a flange at its forward end which transmits the drive through a splined

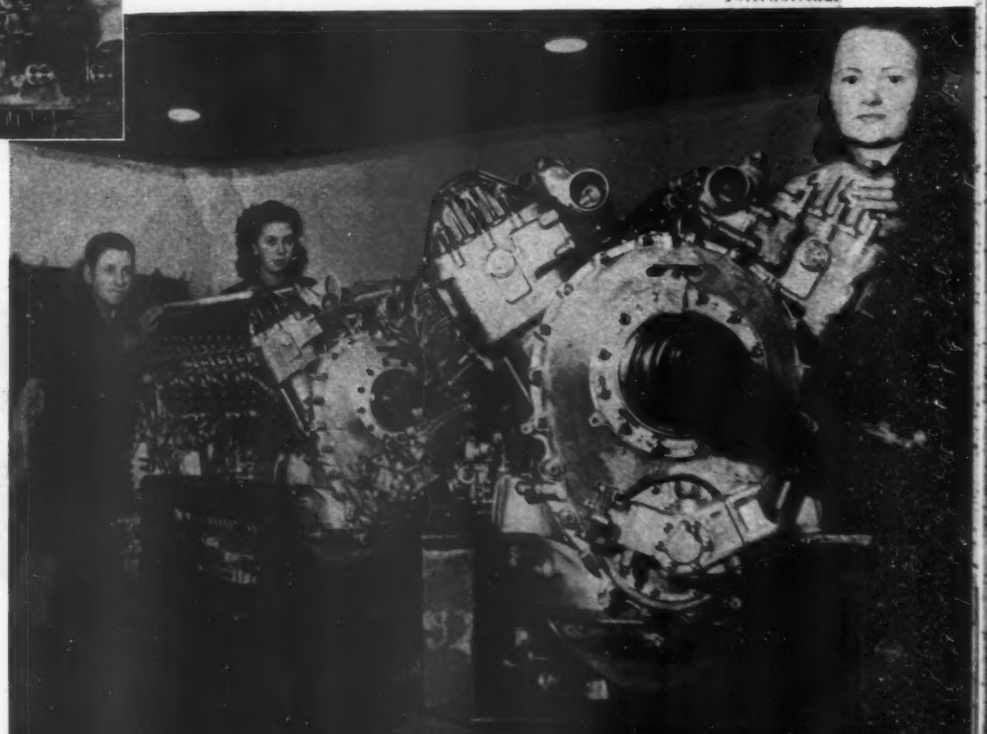
(*Turn to page* 255)



International

A girl at work on the crankcase of the Merlin XX model. Each cylinder block assembly is attached to the crankcase by 14 long studs shown here.

International



Finished Rolls-Royce Merlin XX engines being rolled out by "Merlin" girls. One-third of total labor strength in British plants producing these engines consists of women. Some attend purely automatic machines, each woman taking three machines under her care, while some look after machines which require judgment and experience in operating.

U.S.-Built Bomber Crosses Atlantic in 400 Minutes

—*Aviation, May, 1942*

A civilian ferry pilot flying an American bomber to England recently got on a tail wind and made the trip in 6 hr. 40 min., clipping an hour from the previous record.

The distance is about 2,400 miles; average speed about 330 mph. After setting the mark, with a Consolidated *Liberator*, the pilot still had too much gasoline for safe landing and he was compelled to circle the field for three hours to lighten his load.

It is against the rules for ferry pilots to speed on crossings and violations are punished, but the pilot in this case convinced authorities that his speed was accidental.

The rule against speed is to keep restless pilots from using up their engines by running them too wide out.

THAT'S *Performance Predictability!*

THIS actual news-story, reproduced above, underscores one of many recent achievements of modern aircraft injection carburetion . . . an advancement developed in Bendix research laboratories.

Stromberg Aircraft Injection Carburetion has definitely improved fuel economy. Thus, greater flying range and increased load capacity are attained. And so consistent is the rate of fuel consumption that the pilot is safely justified in remarkably close calculations of a ship's flying-range.

Other attributes of this modern carburetion are: automatic continuous self-adjustment to proper fuel-air mixture for all altitudes, employing fixed-size metering jets; simplification of field service work because virtually identical basic design is employed in the carburetors used on various engine makes and models.

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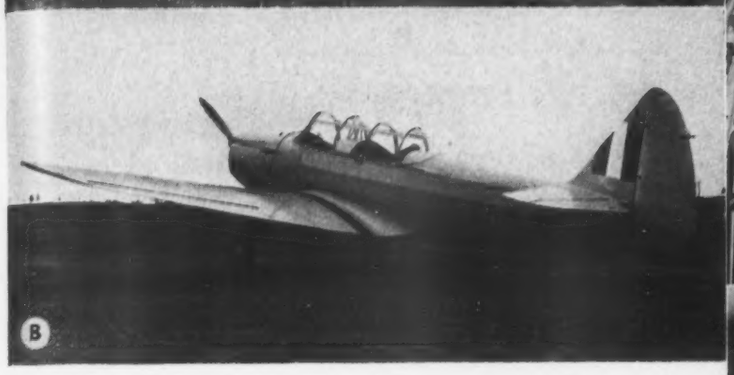
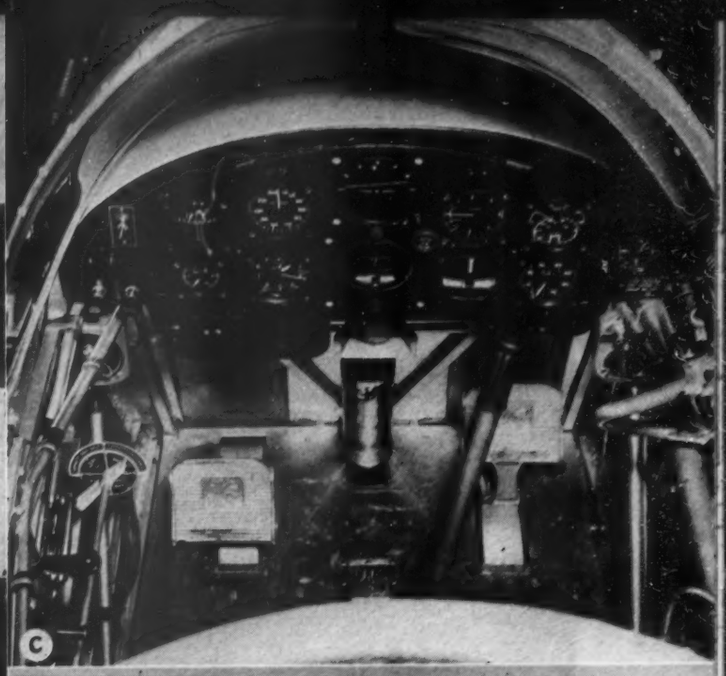
INJECTION CARBURETOR





NEW FAIRCHILD CORNELL

Called the PT-26, latest trainer is a modification of the well-known PT-19A widely used in the United States and Canada.

A NEW FAIRCHILD primary trainer, called the Cornell, has been announced by Fairchild Aircraft Division of Fairchild Engine & Airplane Corp., and bears the designation PT-26. It is a low wing monoplane similar in appearance to the PT-19A and has been completely equipped for night and instrument flying. Combined in it, therefore, are the advantages of both a primary and basic trainer.

There is an increase of 25 hp. in the Cornell over the PT-19A; the Ranger 6-440C-5 engine in the new model developing 200 hp. Fuel capacity is 45 gal. No performance details have been released, but the PT-19A, powered with a Ranger 175 hp. engine, has a high speed of 140 mph. at sea level and cruising speed of 120. The powerplant has a weight of 370 lb. and uses 65, 73, 80 and 87 octane fuel. Design employs positive pressure cooling, air pressure being built up at cruising speeds through opening in the cowling nose.

The Cornell is provided with a generator for electrical equipment and the blind flying instruments include gyro and horizon. Construction is apparently similar to the previous model, including fabric covered fuselage and plywood covered wings, which are fitted with flaps. Landing gear is fixed type and the fixed tail wheel unit is now protected from dust by a covering. Cockpit enclosures slide fore and aft. Engine cowling is of metal.

Now being delivered to the RCAF from the Fairchild plant in this country, the Cornell is also being manufactured under license in Canada. It will be used by the RCAF as the standard elementary trainer, replacing other types formerly used for this purpose.

A. *The Cornell is powered by a Ranger 6-cylinder in-line design. Positive pressure cooling is effected through the "ramming" of air in the oval tunnel opening in nose of cowling shown in this three-quarter front view. Corrugations in the tunnel wall assist in directing air against the cylinders, the tunnel acting as an air pressure reservoir.*

B. *Fuselage of the PT-26 is fabric covered, wings have plywood covering.*

C. *View of the forward cockpit of the PT-26 showing instrument board and controls. Tank selector valve is on left next the throttle, artificial horizon at top center on panel and gyro just beneath.*

D. *In this flight picture of the Fairchild Cornell is shown the removable blind flying hood in the rear cockpit. Electrical equipment generator is under fuselage just below pilot.*

WHEN first they introduced the service—a full dozen-and-a-half years ago it must be, now—old Uncle Ezekiel wasn't one whit impressed. "One of they noo-fangled thingummies, drat'em," he'd mutter, waving his much-charred corn-cob vaguely at the skies as the homing ship roared overhead. "Wouldn't say thank'ee for 'em, no-how. Spoilin' my rest." And he'd shake his grizzled head slowly from side to side and purse his lips vigorously in unsaid (but potent) criticism.

Today, when the great silver ships come gliding down out of the Eastern sky with the sun splashing vivid high-lights on metal cowling and wing-tips, old Uncle Ezekiel scarcely looks up from his chair in the porch. His one action is to call over his shoulder in a cracked, petulant oice: "Late again there, Martha. 'Tis five o'clock by the airybuzzer—**and where's my cawfee?** If yez was only half as efficient . . . ."

"Ay, them planes are real efficient," says Uncle Ezekiel. But he knows nothing of the hours and days and months of hard, unrelenting work in drawing-office, laboratory, factory and hangar that have gone to **make** that efficiency. He knows nothing of the calculations and cross-calculations, the checking and re-checking up to the nth. degree and beyond. He knows nothing, for example, of the importance of competent filtration.

And it is surprising, when all is said and done, how even nowadays only partially-efficient filtration is so often tolerated—with dire effects on working efficiency and engine-life—**when filtration up to 99.9% efficiency is a proved and practical possibility.** This revolution in the recognised standards has been achieved—after long months of patient research in the VOKES laboratories—by the introduction of **an entirely different principle of filtration.** These Vokes filters (both for Aero engines and for high and low pressure oil systems) filter down to particles of 0.00004 in. diameter, and have already been tried and tested under the most stringent practical conditions. Their introduction is of the utmost importance to the aircraft industry. We shall be pleased to answer all enquiries and arrange for demonstrations through our agents

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Cecostampings

WINDOW and DOOR FRAME. At right are shown two sides of the half of a combination window and door frame for a bomber. These pieces are approximately 48" long, made of light gauge Alcoa SO-24, and are excellent examples of very light draws, without the use of rubber. These particular pieces were made on a 66" x 36" CECOSTAMP, the blanks having previously been cut to approximate shape. Handwork was necessary at the corners at the inside of the cutout to eliminate draw cracks in forming this light gauge material.

THE CECOSTAMP

The modern drop stamp for difficult forming of high strength steel and aluminum alloy sheet metal parts.

The Cecostamp is a high production, impact type stamping machine, designed and manufactured by the Chambersburg Engineering Co., for forming high strength sheet metal parts, such as stainless steel and many aluminum alloys. These difficult types of metals are formed with fewer operations and greater true-to-die accuracy, while permitting the operator to control the metal flow of the stamping, thus producing shapes without drawing and the reduction of sectional areas. With a Cecostamp you produce controlled stampings, overcoming the resiliency of hard-to-form metals and giving them a permanent set, at greater rates of production than heretofore possible.

Write for a copy of "Cecostampings," a new publication, just off the press, which contains examples of Cecostampings and details of their production.

CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa.

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IN the nation's Battle of Production there is no power on earth to substitute for foresight in development and leadership in Quality manufacture. That's why American aviation is turning confidently to General now for tires equal to the tremendously increased strain of modern-day take-offs and landings. The streamline, smooth-contour General—used by our armed forces long before the war . . . refined and improved continually to keep ahead of the changing requirements of military flying—is being produced today at an ever-increasing rate. There is no ceiling on General's all-out effort to develop and build products that will help speed our air forces to final Victory.

See your Fixed Base Operator, or write,

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Aviation Division, Akron, Ohio

The **GENERAL** AIRPLANE TIRE

KNOWN AROUND THE WORLD FOR QUALITY AND SAFETY

Inter-American Escadrille Assumes War Role

Inter-American Escadrille war work strengthens ties of American Republics and builds firmer foundations for post-war unity

By JOHN FOSTER, Jr.

A QUIET WORKING civilian pilots' organization founded to make private flying easier between the American Republics has suddenly, under government sponsorship, begun making vital contributions to the war effort.

These contributions, being made by the Inter-American Escadrille, will probably be expanded, serving at the same time to build a foundation for an even wider post-war program to achieve the original objectives.

Outstanding among these objectives, now sidetracked by the war, was a plan "to create an Inter-American Skyway" by which the average, private lightplane flyer could make his way in and out of Central and South American countries with a minimum of expense and red tape. It was to be achieved "by increasing and improving intermediate air fields and ground facilities; by assembling and making available accurate maps and route information; and by reducing expenses, fees, permits and legal red tape in international civilian flights."

Simultaneously the Escadrille planned to assist in creating and enlarging pilot and ground school facilities; organizing international flights and providing model building and primary training opportunities for those of pre-flying age.

Since the war began, however, practically all efforts have been devoted to flight training through projects worked out in close cooperation with the Civil Aeronautics Authority and other government agencies, and the development of Vigilance Patrols, similar to those operated by the Civil Air Patrol in this country.

Official plane of the Inter-American Escadrille, a Grumman amphibian loaned the organization by Lord Beaverbrook, Britain's lend-lease coordinator in Washington. Third from left is Alfredo de los Rios, vice-president of the U. S. Wing and founder of the Escadrille.

Although by far the most progress has been made within the past year, the United States Wing of the Escadrille was organized five years ago. It was set up by Franklin Field, its present president and former partner in a Wall Street brokerage firm, to continue work started in 1934 by Alfredo de los Rios, a former Chilean Army officer and newspaper correspondent and now a United States citizen.

Early supporters of the group included Laurence Rockefeller, Robert Johnson, surgical supply manufacturer, William Barclay Harding, J. P. Warburg, W. K. Vanderbilt and William A. M. Burden, vice-president of Defense Supplies Corp.

Wing organization in the Latin American nations was largely accomplished in March. 1941, when a mission sponsored by the Office of Coordinator of Inter-American Affairs and supervised by the State Department made a circuit of the continent to the south.

Lord Beaverbrook, Britain's lend-

Franklin Field, left, president of the U. S. Wing, and Alfredo de los Rios hold statue of Simon Bolivar. Accompanied by girls representing all the American Republics, they presented this bronze replica of the famous equestrian monument of the South American Liberator to President Roosevelt, a gift from President Eleazar Lopez Contreras of Venezuela.

Lt. Adhemar Lyrio, pilot of the Brazilian Air Force, visiting the United States for special eye treatment, is cooperating with the educational program of the Inter-American Escadrille.

lease coordinator in Washington, loaned the mission his own plane, a Grumman G-21 which is now in the field doing ambulance work. Eastern Air Lines loaned James E. Farris as pilot and Luis Medina of Colombia served as mechanic. Spare parts, radio equipment and other essentials were donated by several manufacturers.

Members of the mission were Gen. Frank R. McCoy and Walter Bruce Howe, both of whom later served as members of the Roberts Commission at Pearl Harbor, and de los Rios. The first two found it necessary to return to the United States before the trip was completed, and were replaced by Warren Simonson, former president of Standard Oil Co. of Brazil.

Meanwhile, Field and Allen W. Dulles, New York attorney, both of whom were in Bolivia on a project for the U. S. Government, organized a wing there.

Wings have now been established in every country except Haiti and the Dominican Republic, and the Escadrille is planning to set up groups there. In every case, formation of a wing has had full government approval, with the chief executive of the nation serving as honorary president in many cases. Officers and directors include cabinet members, military and civil aviation directors, publishers, educators, and others.

Progress of the Latin American wings has, of course, varied largely with the amount of equipment available, but Mexico, Cuba, Venezuela, Ecuador and Peru have perhaps gone farthest in inaugurating long range programs. In Cuba, for example, the Escadrille organized and has maintained patrols with six privately owned ships to prevent sabotage in the vast cane fields. In Ecuador training has been started, using courses developed under the direction and auspices of the wing there.

In Venezuela the wing sponsored dances, picnics, bull fights and other public affairs to raise money. President Eleazar Lopez Contreras made a sizable donation, with the result that the group not only had money enough to buy the first training plane, but enough left over to start a small school. Recently, in Mexico, 30 members were inducted simultaneously. The equipment of the new members, including the personal planes of Gen. Roberto Fierro, Chief of the Air Force, ranged up to Bellancas and Lockheeds. In Peru the wing is assisting in formation of a permanent air governing commission which will correspond to our CAA.

High regard in which the Escadrille is held in South America is illustrated by the case in Ecuador. During the latter period of its long border dispute with Peru, the Ecuadorian government ordered eight Aeroncas for basic trainers. Before their arrival, however, the dispute had been settled, so the government turned the planes over to the Escadrille for use in a school at Manta.

When the United States government began its program of Inter-American Air Scholarships, the Latin American wings participated actively in establishing the boards to select the students to be sent here. Under this program 482 students from the Americas are today receiving training in 19 United States schools. Of the registrants, 200 are taking commercial flight courses, 100 are being trained by the Army, more than 100 are taking Civilian Pilot Training Program courses, and the remainder are being given engineering, flight instructor or service mechanic training. The majority of this group will complete training in July, forming a nucleus for expanded training work in their own countries. It is expected they will be replaced immediately by other candidates.

Although one of the requirements for the students was a working knowledge of English, practically all 19 schools have taken on Spanish speaking instructors to facilitate training. In some cases, special cooks have been hired to make the transition to American food easier. Due to careful selection at the start, "washouts" have been few, it is reported, and the adaptability of the men to discipline and American customs has been remarkably fast. To date, there has been only one fatal crash.

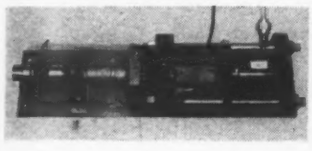
Also in the United States is Paulo Sampaio, Brazil's leading flyer, here as guest of the United States wing. Working in close cooperation with the CAA, Sampaio is making a year's study of United States airline operations, preparing to assume an important position in air transport development in his own country.

(*Turn to page* 259)

In the field of "Balance", a problem confronting the engineer may be one of preventing or correcting unbalance or of maintaining constant loads or equilibrium in a test system. Some instruments which are useful in these problems are:

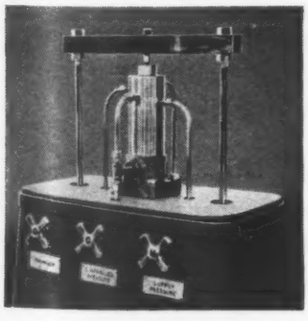
BALANCING EQUIPMENT

A portable set of vibration equipment with which the amount of unbalance in motors, generators and other rotors can be determined and corrected.



TORQUE MEASURING SYSTEM

A flexible system for the accurate measurement of torque or twisting moment in shafts, bolts, and test or production equipment. It consists of a torquemeter pick-up, indicating or recording instrument, test frame and other necessary equipment.



LOAD MAINTAINER AND CONTROL VALVE

An answer to the difficult problem of maintaining loads or pressures in test assemblies with safety and accuracy.

* * *

Other instruments in the field of resistances, reactions, and loads are: Proving Rings to measure static loads or reactions in equipment or structures; Load Plugs to measure pressures or loads in rolling mills and other machinery; auxiliaries, amplifiers; recorders.

He feels the balanced rhythm in a spinning motor's song

It's a motor's grim business today to keep humming; our business to help keep motors fit.

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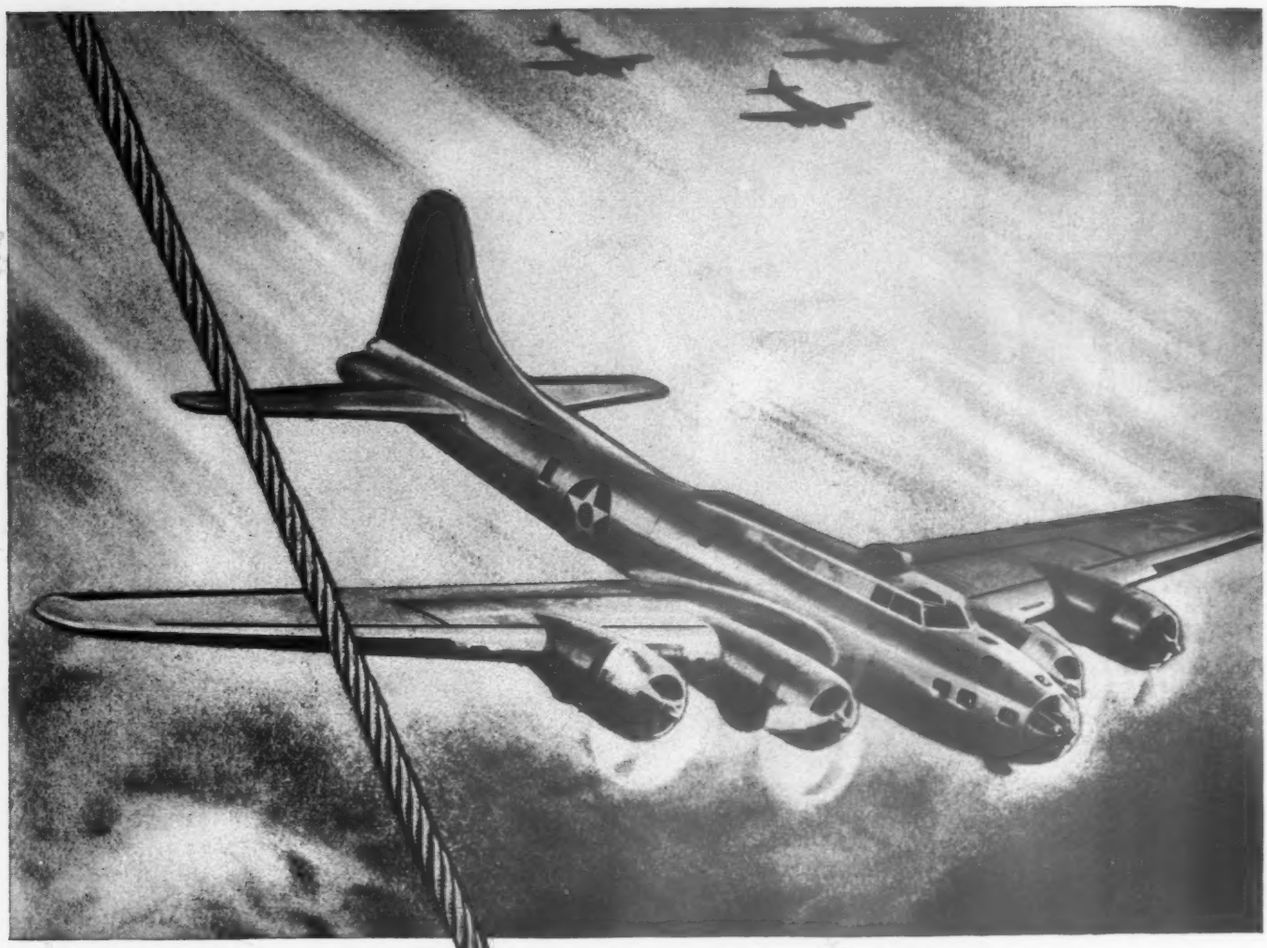

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Before you get your Hazard Cable or complete assemblies of Cable or Strand with Terminals: "A 13 foot sample of each lot (of cable or strand) is given *70,000 reversals over steel pulleys that are no more than 7 times* the diameter of the cable. . . . After this punishment, the cable or strand must still possess 50% of its original rated breaking strength!"

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Those are two items in Hazard's procedure for the production of Aircraft Cable and Strand. And they are quoted to indicate how completely we of Hazard appreciate our responsibility when you come to us for Cable, Strand, Terminals or complete assemblies.

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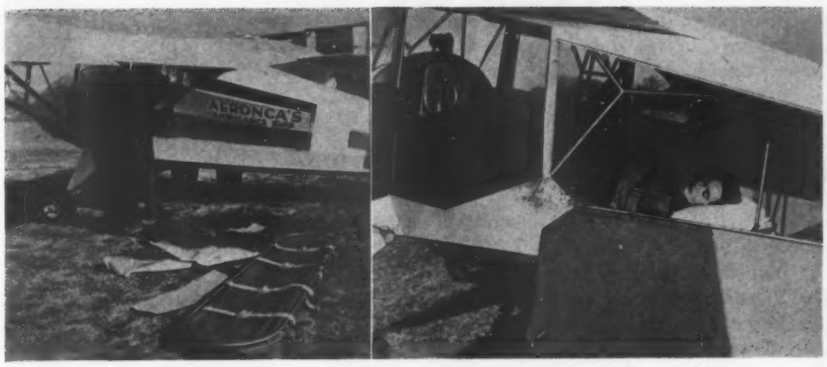


NEW MERCY SHIP

New Aeronca Super Chief ambulance plane, designed for CAP. LEFT: Ready to receive patient is Aeronca-built foam rubber mattress stretcher as entrance hatch to ambulance is opened. RIGHT: Patient is secured by multi-safety belts before hatch is closed preparatory to take-off. Large space available can also be used for delivery of medical or other essential supplies.

CAA Trains for Overseas Work

The first group of civilian flight officers trained for commercial service overseas by CAA has been graduated by Northeast Airlines' Pilot Training Division at Burlington, Vt.

Graduates of CAA's controlled pilot training course, the men are destined for American transport service abroad after having passed an intensive advanced course in navigation, meteorology, instrument flying, general airline procedures and operation of multiengine equipment.

Meanwhile CAA is training three classes of pilots for the Army Ferrying Command at the CAA Standardization Center, Houston, Tex., under the direction of Bennett H. Griffin, trans-Atlantic flier and instrument flying pioneer.

One class has already been graduated and is already seeing service all over the world, Acting CAA Administrator Charles I. Stanton reported, with successive classes scheduled to complete the course every ten days.

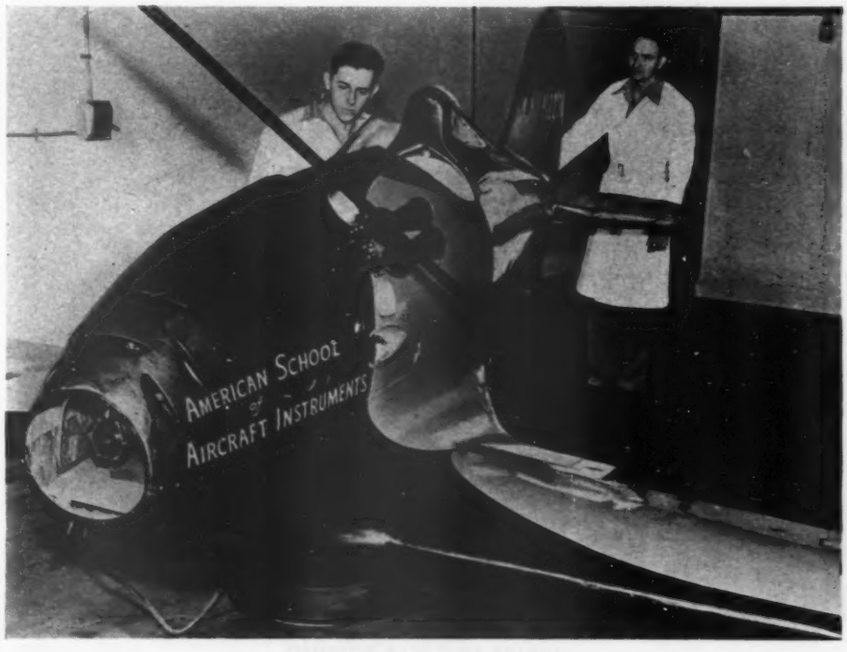
Wanted: Flying Instructors

The Army Air Forces Flying Training Command needs 2,000 instructors—now.

Licensed pilots between 21 and 42 with more than 140 logged solo hours who can meet the Commercial Pilot's Certificate physical requirements are eligible to make a vital contribution to the war effort and earn up to $300 a month at the same time. They can become commissioned officers in the Air Forces, with a service pilot's rating in addition to getting their Commercial Pilot's Certificate and instructors rating.

A new course, organized under direction of the Air Forces, has been set up to condition and qualify pilots who heretofore have been unable, for various reasons, to find a niche in wartime flying.

Many men who could—and would like to—qualify as instructors are today engaged in other work because of private flying restrictions or because they feel their present work is what they should be doing for their country, according to CAA. Some, of course, are in "essential" industries and would have to secure written permission from their employers to be accepted, but many others could give valuable service in



turning out the pilots necessary for victory and a return of private flying.

The need for instructors is so serious, CAA reports, that it has been necessary to take boys who have never flown before and train them first as pilots, then give additional training to make them suitable instructor material. The opportunities for instructors are so numerous that several thousand such men are today serving as instructors throughout the nation.

The nearest airport can put interested men in touch with their local CAA representative.

ON PATROL . . .

• *Helping sink Axis submarines* off the East Coast, rushing vitally needed cargo for military use and speeding shipments of ore and other vital war materials have all been credited to the Civil Air Patrol as it adds proof of its worth in the war.

• *Major General Follett Bradley,* com-

FROM RACING TO TRAINING

Former racing plane now serves as instrument checking and demonstration craft for students. Mounted on universal joint, plane is motor-operated to roll, pitch and yaw, simulating actual flight attitudes and giving students opportunity to check instruments they have repaired and installed in regular instrument panel.

manding the 1st Air Force, Eastern Defense Command, revealed that members of a CAP "test force," operating from an undisclosed base, have sighted submarines about to attack tankers carrying oil to America's overseas groups and forced them to crash dive without releasing torpedoes. In addition, several sinkings scored by Army and Navy bombers have been credited directly to tip-offs by the civilian flyers assigned to patrol work over Atlantic waters.

• *In the first 20 days of an experiment* —success of which presages much more work for CAP—Pennsylvania's wing flew 2,770,000 lb. mi. of cargo from Maine to Florida in 270 flying hours. Ships used ranged from a 65 hp. Cub *Coupe* up to a 220 hp. Waco.

• *For the first time in history,* aerial targets have been towed by civilian planes and fired upon by Army gunners. This mission was accomplished by the Illinois wing after successfully carrying out missions to aid Fort Sheridan's anti aircraft unit in sighting and tracing practice.

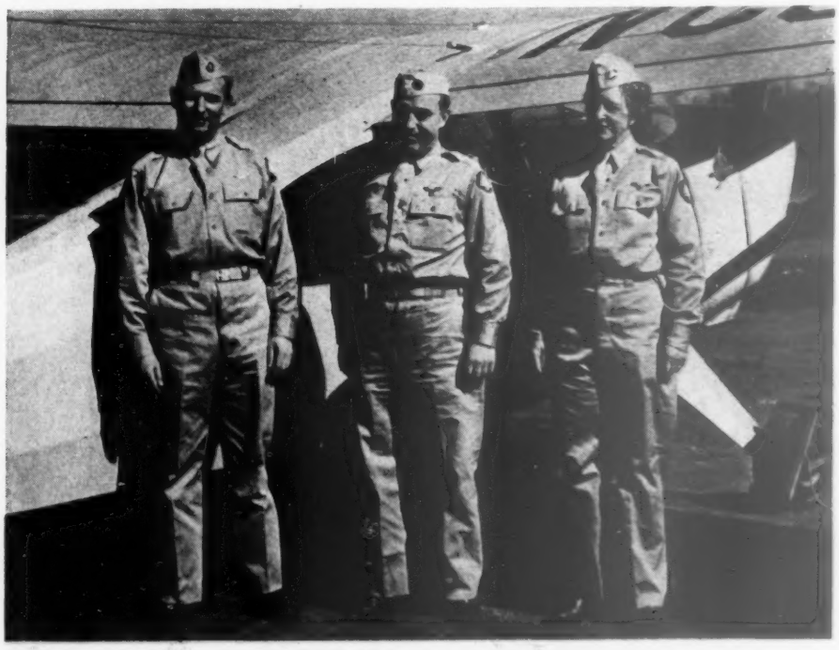
• *New Wing Commanders include:* Rex P. Hayes, Ark., replacing Gilbert Leigh, ordered to active duty, Army; H. H. Anderegg, Colo., replacing W. W. Agnew, ordered to active duty, Navy; Cary W. Ulrich, Ky., in place of A. H. Near, ordered to active duty, Army Air Forces; George A. Stone, Ohio, succeeding Earl L. Johnson, now CAP National Commander; and James B. King, Wis., replacing Seth W. Pollard, resigned.

• *New York State Wing* has more than 3,000 members; Oklahoma has 1,221, or 45.2 percent of the state's pilot population . . . Keith Kahle, Oklahoma Wing executive officer is awarded Jerry Sass Trophy "for outstanding work benefiting Oklahoma's aviation." He's 32, the youngest ever to receive the trophy . . . In the works: CAP officials and interested federal agencies confab on forest patrols; already some wings at work assembling equipment and starting training.

ALONG THE APRON . . .

• *Basic aviation training* will move into high schools throughout the nation so that by the fall of 1943 some 2,000,000 boys between 16 and 18 will have had study in both theory and mechanics.

Based on experiments among 1,500 boys in 13 New York State public and private schools, the new course will be made available by Air Training Corps



INDUCT NEW CAP RECRUITS

Heber Sutton, commander, Squadron No. 3, New York CAP Wing, (center) with Gunther G. Wallen, operations officer (left), and Mrs. Marion Cummings, flight leader of special missions (right), discuss projected program at Westchester Airport following induction of large group of new members. In addition to flight exercises, squadron is currently engaged in navigation and meteorology course.

of America to the first 500,000 beginning next September.

• *Meanwhile, the Navy announced plans* to train 40,000 men annually in privately operated schools in elementary electricity and radio material, visual signaling and as radio operators.

• *E. W. Wiggins, treasurer and founder of Wiggins Airways, Inc.,* Providence, R. I. and Wesley H. Marden, president of Airways, Inc., Waterville, Me., will build and operate Army Civil Contract training school at Camden, Ark. The new school will comprise a central airport and three auxiliary fields, and will be capable of housing and training 500 students every nine weeks.

• *Boeing Aircraft Co. establishes mechanic-training center.* in Seattle's Civic Auditorium to train Air Force mechanics in *Flying Fortress* maintenance and repair. Boeing engineers will serve as instructors and trainees will get first-hand experience on B-17s right at Boeing field.

• *Aero Industries Technical Institute, Los Angeles,* is doubling enrollment through contract to train selected Army men in specialized phases of aircraft and engine maintenance. Program requires addition of new 18,000 sq, ft. hangar for shop work, six barracks, mess halls, kitchen, canteen and recreation hall.

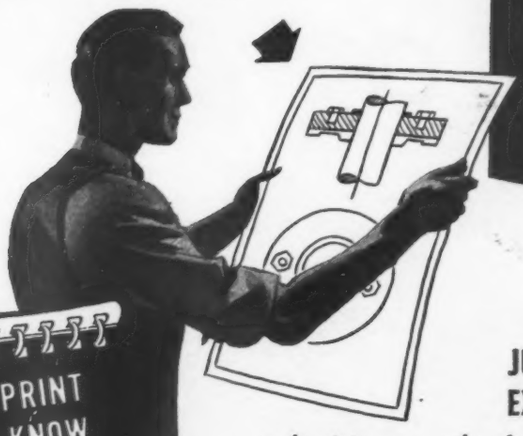
• *University of California at Los Angeles* has inaugurated a manufacturing operation analysis course under A. V. Sales, Lockheed manufacturing engineer, to "train qualified men in the principles and practices involved in analysis of manufacturing operations." Also offered by UCLA are courses in safety engineering, office procedure and basic accounting.

Abrams Completes Cuban Aerial Survey

Abrams Aerial Survey Corp., has just completed an extensive air mapping project in Cuba, the third major Caribbean aerial survey conducted by the firm since 1936. Lee Crossman of Marin, Ind., and Elmore Kerkela of Minneapolis, Minn., functioned as pilot and cameraman, respectively, using a Beechcraft.

FROM TRACING TO FINISHED WHITEPRINT...

IN 2 FAST STEPS



BASIC FACTS ABOUT PRINT MAKING YOU SHOULD KNOW

OZALID TRANSPARENT FOILS ARE USED TO RECLAIM OLD, WORN, OR SOILED ORIGINALS . . . thereby enabling you to make prints from valuable originals which otherwise are no longer serviceable.

The lines on marred original tracings are intensified in duplicate originals made with Ozalid acetate foil. Any spots, blotches or crease marks reproduced on a duplicate original can either be erased, or cleaned with Ozalid Corrector Fluid.

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This is the fifth of a series of facts on modern printmaking. Watch for Fact No. 6.

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Each month more and more Vought "Kingfishers" are roaring away from Stratford to join the United States Navy. Recently cited for successful attacks on enemy submarines, these sturdy observation scouts are serving the Navy in the same high tradition established by the first Navy Voughts twenty-five years ago.

VOUGHT-SIKORSKY AIRCRAFT
STRATFORD, CONNECTICUT
ONE OF THE THREE DIVISIONS OF UNITED AIRCRAFT CORPORATION

The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington C. B. F. MACAULEY, New York RANDOLPH HAWTHORNE, New York E. EUGENE MILLER, New York

Army Requisitions Half of Airline Planes Remainder Stands by for Emergency Routes, Trips, Cut; Priorities Ordered

Washington (AVIATION Bureau)—No one was surprised on May 15 when the Army ordered requisition totaling about half of the airlines' planes, curtailment of all but essential routes and schedules, and early priority on travel space and mail service.

The airlines's existing fleet of more than 300 planes, mostly DC-3's, is apportioned in the following manner. About one-half of the total is left on remaining routes and schedules in civil service, but these are to stand by for "emergency military missions." Seventy ships—approximately the 25 percent recently ordered requisitioned—are being converted by the airlines to cargo carriers, and these will be flown and serviced by the regular operators under a non-profit contract with the Army. They will carry military traffic, troops and cargo, presumably within the borders of the United States. "A substantial proportion"—about 100—remaining ships are being transferred outright to the Air Forces for operation by Army personnel in the various Services and Commands.

"All routes and services not regarded as essential to the war program will be terminated," says the Army's announcement. The Civil Aeronautics Board had completed a proposed program of curtailment and was discussing it with the airline operators as this was written.

Airline officials in Washington said they would continue to cooperate with the government to the fullest extent, as they had in the past.

A strict system of priorities, to be administered by agencies yet unnamed in various parts of the country, was being set up. Air travel vital to the country's needs will continue, but all persons who can go by train will be required to do so.

Air mail will be flown over the curtailed route and schedule system, but this service too may be cut down still further, and observers said all but essential air correspondence would be stopped eventually.

Various officials said privately that they did not believe any more airplanes would be delivered to the airlines for regular service. The War Production Board months ago allocated a good supply of planes to the lines for this year and for the first part of 1943. It is believed that such of these allocations as are delivered will be equipped for Army service.

No one could say whether any remnant of the airline system as such would remain for the duration of a long war. But the Administration appeared determined to keep intact as much of it as possible. Value of civil air system to the public welfare is still unquestioned. The Army's action was everywhere accepted as necessary in the emergency.

Wright Appointment

T. P. Wright, assistant chief of the Aircraft Branch, War Production Board, has been appointed a member of the NACA main Committee where he will assist in directing aeronautical research in the country. At the same time, Mr. Wright will continue with his duties as assistant chief of the WPB Aircraft Branch, where he is associated with many outstanding men in the aviation field.

His work and experience have gained for Mr. Wright an international reputation, not only as an aircraft designer and engineer, but particularly as a production expert and managerial executive. Starting as inspector of naval aircraft during the last war, he then became associated with what is now the Curtiss-Wright Corp., whom he served as assistant factory manager, assistant chief engineer, chief engineer (research and production), vice-president and general manager of the airplane production manufacturing unit of Curtiss-Wright. Finally, at the time of his call to Washington to assist in the work of the WPB Aircraft Branch, he was vice-president and director of engineering responsible for coordinating engineering and production activities of the several plants of the organization.

Press Association, Inc.

"RAT POISON"

Private William O. Driscoll of Lafayette, Ind., on the alert behind two 50 cal. guns in a B-17E about to take off for patrol duty from an air base somewhere in Guatemala.

Winding up the details of a huge training program for commissioned and enlisted personnel of the Army Air Forces, looking to the servicing of aircraft engines produced by General Motors, are, left to right, Capt. J. H. Phipps, Air Corps Dept. of Individual Training; C. G. Edmonds, Buick regional manager; W. F. Hufstader, Buick general sales manager, and Maj. Dalls M. Speer, Training Operations Section, Air Service Command, Wright Field.

Airline Blackout

Prophetic indeed was Army's order, a few days before military control was placed over the airline system, that window curtains be drawn until three minutes after take-off or landing and three minutes before and after passing military or strategic installations.

The object, of course, is to keep persons who might have subversive tendencies from seeing what's going on.

But restrictions were soon made more comprehensive than the order said. On one trip recently, the writer sat behind drawn curtains for 250 mi. while shipyards and plants previously observed in the bright lights of the night shift, passed underneath. The stewardess said the curtains would not be opened till the trip reached the mountains.

United Nations Rush Air Training Plans

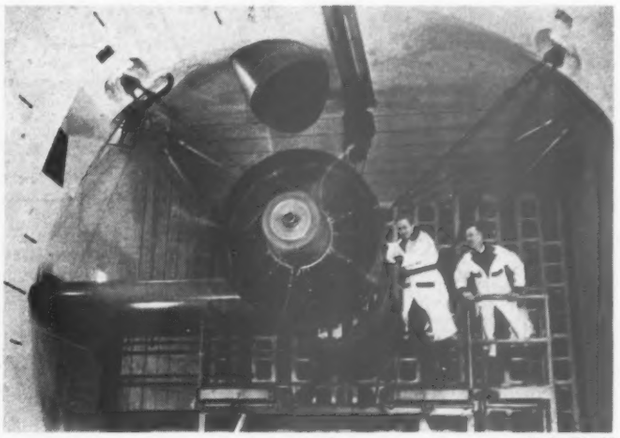
High school graduates between 18 and 27 may qualify to become aviation officers with the rank of ensign in the Naval Reserve or second lieutenant in the Marine Corps Reserve. The cadet training program takes 3 to 4 months at a pre-flight training center. Cadets under go three months of primary flight training and a similar period of advanced training.

The Air Training Corps of America expects that by the fall of 1943, 2,000,000 boys between 16 and 18 will have had instruction in aeronautical theory and mechanics. ATCA is a program organized privately for high schools under leaders in aviation, government and education. Beginning this September, high schools will offer to junior and senior students five basic subjects—aerodynamics, navigation, communications, meteorology, and engine design and structure—as part of their two-year course of pre-flight studies.

Light airplane and glider schools are being established in the Middle West, to train glider pilots. Men from 18 to 35 who have had training as civilian pilots and who have been ineligible for aviation cadet training may qualify as glider pilots. Light airplane instruction is given by CPTP schools of the CAA. The preliminary light airplane instruction will not be a flying training course for beginners, but will serve as a "refresher" for pilots already holding certificates but who have not kept up their flying.

The Navy Department announced that authorization has been given for construction of two new Aviation Technical Schools to be located at Memphis, Tenn., and Norman, Okla. When completed, each center will have facilities to train 10,000 men every six months. Purpose is to turn enlisted men into trained technicians required for the maintenance and operations of aircraft, engines, guns, radio and other equipment.

Several hundred Netherlands soldiers, presumably from the Dutch East Indies, have arrived in this country from Australia, to undergo aviation training, the War Department announced. A recent agreement between United States and the Netherlands provides for the use of an air base by the Dutch as a training center for about one and a half years.



Wide World

Aircraft engine being tested on one of the two torque stands included in the engine propeller research building, aircraft engine research laboratory which began operations early last month.

The United Kingdom, Australia, New Zealand and Canada have started a program to train aircrew-pilots, observers and wireless-air-gunners. The plan includes over 140 centers across Canada, of which about 100 are actual training schools.

Wright Engine Workers Praised by Lovett

The men and women who built the engines that carried the B-25 bombers of the Army Air Forces from Australia to strike at Japanese bases in the Philippines, received recognition for their craftsmanship from Robert A. Lovett, Assistant Secretary of War for Air.

The B-25's used in the raids are twin-engined bombers powered with two 1,700 hp., Wright *Cyclone* 14 engines. Mr. Lovett's telegram, addressed to all Wright employees, cited the action in detail under the leadership of Gen. Royce, and then stated, "Your workmanship helped get them there and bring them back. We recognize that fact and know you join with us in pride of their achievement."

Army Gives "A" Award

The War Department created a new award, the Army "A" Award, to be conferred upon war production plant, including aircraft, and workers conspicuous for outstanding performance in Army production. The award is in the form of an Army "A" Flag for the plant and a lapel button for each worker. Lt.-Gen. William S. Knudsen, director of production, is chairman of the Army Board for Production Awards, set up to formulate policies and rules governing awards.

Government and private plants; those engaged partly and wholly in war work; subcontractors and prime contractors, all have an equal chance for the award. Quality and quantity of production will be the factors to govern the recipients for the award. Other contributing factors include: overcoming production obstacles; avoidance of stoppages; maintenance of fair labor standards; training of additional labor forces; effective management; record on accidents, health, sanitation, and plant protection; and, utilization of subcontracting facilities.

New Air Honors

President Roosevelt ordered the striking of a new "Air Medal" for award to members of the Army, Navy, Marine Corps or Coast Guard distinguishing themselves "by meritorious achievement while participating in an aerial flight."

Aside from the Distinguished Flying Cross, this is the only decoration for specific feats of heroism and meritorious service in the air.

Under Mr. Roosevelt's executive order, no more than one air medal shall be awarded any one person, but for succeeding meritorious achievements justifying such an award, a suitable bar will be awarded to be worn with the medal.

The new medal may be awarded by the Secretaries of War, Navy or Treasury or commanding officers of the Armed Services to whom the power is delegated.

Coastline Defense Units Geared for Offense

Aerial attack units that converge swiftly from all directions upon a single point of danger put offense into the defense of America's far-sweeping coastline. A stationary line of defense is formed by coastal bases from which a flash call provides the means for sudden offense offshore.

The First Air Force under the command of Maj. Gen. Follett Bradley, is charged with the air defense of the Eastern Seaboard. It operates through three tactical commands—The First Interceptor Command, The First Bomber Command, and The First Ground Air Support Command. Seven days a week, for 24 hr. a day, they lay a blanket of protection over millions of people, from Maine to points far south in Florida, reaching far out into the Atlantic.

How far planes of the First Air Force may range in their operations is determined by the mission assigned them, by the situation at hand, and other conditions that are constantly changing.

AAF Day Raid Was Low and Fast

Washington (AVIATION Bureau)—After a fortnight of silence on the bombing of Japan, the Army announced that Air Force bombers had done the job, flying so low that it was necessary to slither between barrage balloon cables.

So fast did the air mission travel that no Japanese were able to get up and follow them to learn their destination. The enemy still does not know where the bombers came from, or where they went—except the one that was interned in Russia.

When the raid started, a radio station in Tokyo was broadcasting propaganda in English, telling the joys of living under no threat of bombing. As the shots crashed, the Japanese became excited, and later in the afternoon, announced three or four thousand casualties.

The people were asked to pray for rain to stop the fires, which, according to Japanese radio, were under control 48 hr. later. When the Japs calmed down they announced damage to schools, hospitals, etc., in the usual Axis manner. But the Army says the targets were selected and were unmistakable and were accurately attacked.

CAA Perfects New Plane Turntable

The old method of locking one wheel to turn planes in close quarters gets worse as ships get heavier. It scrubs the rubber off the locked wheel. When a B-17 turns on a wheel the tire smokes. Also, planes parked in close quarters cannot move, sometimes, if they are supposed to go out in sequence and one is stalled.

Washington National Airport was among the first to have stationary turntables. They work fine, except that the pit collects water and the installation rusts. But main trouble is that the turntable isn't always where you want to put the plane. This is especially true in military operations. The table is for one wheel only.

Airport Division of the Technical Development Section of CAA has worked out a portable turntable in cooperation with International Stacy Corporation. It is a plate 4 ft. 6 in. diameter, 2 in. thick, in a mounting 5 ft. 6 in. in diameter, resting on 199 five-eighth in. ball bearings, protected by two half-inch felt seals. Tests have been satisfactory, excepting a slight creep on the ground, which can be remedied. Canada and other countries are interested.

AAF Reserve Formed

At meetings held by Aviation Cadet Examining Boards at colleges throughout the country, over 60,000 students heard officers explain the AAF Reserve program which permits qualified students to enlist as Aviation Cadets and continue their education until actually needed for training. After a mental and physical examination, those who qualify will be enlisted with active duty deferred. Students enlisted under this plan who are graduated, will be appointed as cadets, with opportunity to compete for commissions. If necessary, any reservists may be called for active duty at any time.

Post Grad Mechanics

Thousands of Army Air Forces mechanics will receive "post graduate" training each month in the factories of the aircraft industry producing combat planes and engines under a new factory training program for enlisted men. The program is already in operation in over 20 plants of the leading aircraft manufacturers.

Only men already trained in aviation mechanics will be sent to these schools in factories producing combat airplanes, engines, propellers, gun turrets, and other units. Courses are from two to four weeks, depending on type of training, with classes varying from 10 to 600. Classes will be limited to the facilities of the factories to feed and shelter the Air Force personnel involved.

Pratt & Whitney to Build Three New Plants

Further expansion in the production of Pratt & Whitney engines was recently indicated by an announcement that the P & W Division of United Aircraft Corporation will erect three plants in the New England area for the manufacture of engine parts. These plants will be located at Willimantic, Conn., Southington, Conn., and East Longmeadow, Mass.

The three buildings will be similar in general size and construction, and in the interests of the conservation of structural steel, reinforced concrete will be used for the frame and roof spans.

Ground has already been broken for the Willimantic and East Longmeadow plants, and work will be rushed to completion at an early date.

2000 Pilots Wanted

The Army Air Forces Flying Training Command has asked the Civil Aeronautics Administration to produce 1,000 elementary and 1,000 secondary pilot instructors by June 15. Qualified applicants will be hired as Trainee Instructors at $3,600 per year, and after flight training will be recommended for commission in the Army.

Qualifications include men from 21 to 42 years of age. They must hold Commercial Pilot Certificates rated at 250 hp. or more and must pass the Army flight physical examination. The course requires 200 hr. for an instructor's rating and lasts a maximum of eight weeks.

AWPC Pools Ideas Exchanges Services

To speed production of warplanes to the limit, the Aircraft War Production Council, Inc., is pooling ideas, materials, manpower and equipment of all plants in one section of California. Eight major aircraft builders of southern California form the council.

Hydro-press machines of one company turn out templates for another. A third company loans a fourth a group of much-needed engineers. Engineers and research men jointly are working out a hydraulics problem.

Recently the council was incorporated, and seven functional groups were set up which include: production, materiel, engineering and standards, transportation and housing, plant defense, accounting and industrial and public relations. Complete interchange of men or materials without regard to individual company competitive interests, is worked out by the council.

Flight Strips Will Take Largest Planes

Construction of flight strips along highways has been started, the War Department announced. Vital to civil and military aviation, the first of a number of flight strips to be developed jointly by the Army Air Forces and the Public Roads Administration, is under construction along the Atlantic seaboard.

Study has been made of similar sites for flight strips throughout the country. The strips will be built to take care of the largest bombardment planes of the AAF. Such strips can be built at a cost of about one-twentieth of that for a large air base.

The flight strip has a single runway extending in the direction of the prevailing wind, with concealed or camouflaged dispersion points for aircraft. A minimum of war materials is required.

The flight strip has a single runway extending in the direction of the prevailing wind, with concealed or camouflaged dispersion points for aircraft.

More Navy Blimps

Navy has requested of Congress the authority to increase the number of lighter-than-air craft from the present 48 to a total of 72. Under Secretary of the Navy Forrestall also asked that the Navy be permitted still further to increase the number of blimps if "necessary to meet the needs of the national defense." He pointed out that this latitude in authority would provide the same flexibility for the procurement of non-rigid lighter-than-air craft as is provided for airplanes.

KITTYHAWK STRIKES

Some impression of what an enemy pilot faces when he clashes with one Curtiss Kittyhawk fighters is obtained from this unusual photo taken on the firing range.

CALLING NAMES

William L. Wilson, formerly director of public relations for Republic Aviation has been named director of industrial relations for the company, while **Thomas W. McDonald** becomes public relations director.

George A. Meyrer and **Mundy I. Peale** are elected vice-presidents of Republic Aviation.

North American elects: **Ralph Ruud,** assistant factory manager; **Rulon Nagely,** assistant director of material; **William Zuetell,** purchasing agent; **K. P. Bowen,** assistant factory manager; **J. W. Hinchliffe,** purchasing agent; **Carlton Wolf,** assistant factory manager; **W. T. Lynn,** purchasing agent.

Robert B. Burnett is appointed superintendent of maintenance for Mid-Continent.

Capt. Robert S. Fogg is appointed regional commander of the CAP, First Corps Area, New England States.

Alfred F. Wieland, and **A. E. Smith** are appointed factory managers of Plant 2 and 1 of Curtiss Wright; **George L. Baum** is made production manager.

John A. Collings, 41, is appointed general operations manager of Transcontinental & Western Air.

Bob Neff, assistant director of public relations of Pan American Airways, is on loan to the Air Transport Association, in Washington.

Five new men are elected to the board of directors of Penn-Central Airlines. New Directors are: **Frederick R. Crawford, R. S. Richards, Capt. J. H. Carmichael, George R. Hann,** and **Jean Cattier.**

Eugene W. Norris has joined the staff of the technical department of Aeronautical Chamber of Commerce.

William G. Zink, of B. F. Goodrich Co., is now in charge of a new aviation branch office in Dallas, Tex.

Allan A. Barrie, veteran Western Air pilot, is appointed a Major of the U. S. Army Air Forces.

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Plastic Meeting Gets U. S. Aircraft Program

Hot Springs, Va., May 4 (Special)—Henry Sang of the U. S. Naval Aircraft Factory announced to the Annual Meeting of the Society of the Plastics Industry details of a government plan for accelerating use of plastics in aircraft construction.

Heretofore, lack of coordinated activity and limited engineering personnel have retarded the industry in constructive aviation effort. A central engineering committee is being set up sponsored by a subcommittee on plastics of the Army-Navy-Civil Executive Committee. Membership of the central committee will include Army and Navy personnel, plastics industries representatives selected by SPI and aircraft representatives selected by the Aeronautical Chamber of Commerce.

The central committee will act as clearing house for all questions of the aircraft industry as to plastics applications; will determine needs and uses; will conduct research and testing through pooled facilities of government and plastics industry; will establish nomenclature, standards and classifications.

The government will publish findings in regular ANC publications. ANC specifications on wood structures are to be combined with plastics, thus throwing together all plywood and plastics as a major materials classification. The central engineering committee will immediately collect all mechanical data and fill in gaps not available now. It will allocate production to avoid duplicated effort. It will maintain a permanent exhibit of aircraft parts and will publish a schedule of parts under three standard classifications: (1) Suitable for immediate plastics application; (2) can be fabricated with known materials as need arises; (3) subject to research and development.

Motorists Sign Here Pilots Fill It Up

For once the air pilots have got it on the road pilots. Ever since government regulation took hold of aviation, when airplanes were in short wheelpants, aviators have been filling out bales of cards and blank forms about the color of their eyes and when did they last clean their distributors.

Now, as gas rationing grips the nation, it looks as if you pay your money and take your petrol, while the automotorists sign here and get their tickets punched for enough firewater to roll to a picnic in South Windgap. You may think your airplane burns a lot of gasoline but the national aviation total is like a bird bath compared with Niagara Falls for the highways. Airlines and all civil flying are exempt from the ration.

War Cancels SAE Meeting

Due largely to continued presence of diplomats of enemy nations at White Sulphur Springs and uncertainty of transportation to some other place, the Annual Summer Meeting of the Society of Automotive Engineers has been canceled, John A. C. Warner, secretary and general manager has announced.

Material which was to have been presented at the session will, however, be brought to the society's membership through special local meetings and a "Summer Meeting Issue" of the *SAE Journal*, he said.

Navy Research On Instruments

The Navy Department has announced establishment of a basic research project on specialized aviation instruments at the Mellon Institute of Industrial Research. Currently engaged on behalf of the Bureau of Aeronautics are Dr. George E. Barker, George E. Alter and Charles E. McKnight, with other specialists to be added to the staff as the research progresses.

Ground Officers' School

An Air Corps Officer Candidate School to train men as commissioned officers for administrative duty has been established at Miami Beach, Fla. Air Corps enlisted men, Warrant Officers and Cadets who have failed in some phase of flying training and have been recommended by their school commandants, are eligible for the training. The course will last 12 weeks and upon completion, graduates will be commissioned Second Lieutenants.

Photoelasticity Conference To Boston

The 15th semiannual meeting of the Eastern Photoelasticity Conference has been called for Saturday, June 20, at the University Club, Boston, Mass., according to W. M. Murray, chairman, executive committee. Inquiries should be addressed to Mr. Murray at Massachusetts Institute of Technology, Cambridge, Mass.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Despite schedule curtailment, two airline systems for certain, and no doubt many others, are showing huge air express increases this year over last. They say the war and increased sales pressure by Railway Express Agency are doing the trick. Under the surface, a great air cargo push for peacetime is brewing. It will be free for all comers, and one of the big jobs will be the creation of a ground service worthy of air speed.

The Stubblefield Award goes to the high service officer (unnamed but real) who boarded a transocean airliner and raised a rumpus because more than half the seats were empty—and important war travelers waiting on both sides! The officer had to be told that the airplane was staggering under a load of strategic war gear, including some spare engines, which he couldn't see.

Did you hear President Roosevelt's radio report on the B-17 which came out of battle in the East with two engines dead, tires shot flat, and otherwise a flying wreck. Here is the rest of it. The B-17 was out of ammunition, and so were two Japanese craft which had been fighting it. The two Nippons came alongside, peered in wonderment, tried to see what went on inside.

The Boeing Clippers on the Atlantic have just celebrated their third year of service. They had only five months of peace at the start. The rest has been war, with blacked out windows and radio and other tribulations. Nobody on an Atlantic *Clipper* has got his feet wet yet.

The Battle of the Carlton in Washington is quite a sight. (But don't come to see it unless you have to.) Go into that famous hotel to see one aviation man, and you'll see dozens. It's surprising how many are the same boys who started and flew the airlines and the first big airplane plants, so long ago. They look much the same—only about 20 years older, as one of them said when he saw your correspondent.

Biplanes are going out of British elementary training, RAF feels that the advantages of low-wing monoplanes in the very early stages of training are very slight, but worth the change. As biplanes are used up they will be replaced with monoplanes.

Dive bombing will meet serious competition by level bombing if accuracy of the latter increases. Some officers already are debating the future of the aerial toboggan type of air combat. This is something for mere speculation, not present conclusions. Level bombing seems to have advantages over Japan, whose airplanes apparently are not capable of getting up to our altitudes.

A pet lamb would have more chance with a pack of coyotes than a good CAA radio man has against the Army officers who want every signal expert in sight, for missions all over the world. But Army is trying to leave enough good men on the job to maintain the airline system and serve as a nucleus for development of more men.

Death claims on pilots of RAF and British Fleet Air Arm are being paid by Colonial Mutual Life Assurance Society, where policies were dated before March 9, 1939. A clause against flying is waived.

The lumber men are cocking an eye at the shift to wood in airplanes, and wondering what they can promise themselves after the war in the way of aviation business. One of them asked this department what about it, and we said we didn't know. And we don't.

March Plane Output 70% Over November Engine Production Up 68% Same Period Man-Hours Per Plane Greatly Reduced

Washington (AVIATION Bureau)—March aircraft production was 70 percent greater than the output in November, the month before Pearl Harbor. This statement was made by Col. John H. Jouett, president of the Aeronautical Chamber of Commerce.

Partly responsible for this increase is a steady reduction in man-hours per unit. In March the industry was able to build five and one-third fighter planes in the same time it took to build four such planes last November. The reduction in man-hours is due to production line methods and improved tools. Of course part of the increased rate of production is due to new plants coming in.

The boost in output is all the more remarkable in view of the fact that materials are increasingly difficult to get and some plants have had to reduce their work forces for limited periods.

During the four-month period since the Japanese attack, the old-line aircraft engine industry combined with the automobile industry stepped up aircraft engine output, in horsepower, by about 68 percent.

Col. Jouett said that during the four-month period the output of four-engine bombers increased almost 200 percent. Thus the tonnage increase in production is even more spectacular than the unit increase. We have 20 new types of combat planes in process of development now, and this engineering work will continue without interruption to keep American superiority of performance.

BELL WINS NAVY "E" FOR ORDNANCE PRODUCTION

Comdr. Robert S. Smith, Jr., U. S. Navy resident inspector of materiel, congratulating President Lawrence D. Bell of Bell Aircraft Corp., after awarding the company the Navy "E" for excellence in production of its Ordnance Division. Left to right: Lt. Comdr. John T. Tuthill, U.S.N.R. public relations officer of the Third Naval District, Mr. Bell, Lt.-Comdr. William J. Conners, Jr., Comdr. Smith, and Lt.-Comdr. Hayden Crocker.

WPB Issues Order On Machine Tools

Washington (AVIATION Bureau)—Because it was impossible to apportion vital machine tools equitably under the priority system to the several war production users, the War Production Board has issued a major order, E-1-B, distributing the tools under specified percentages.

The order gives 75 percent of all strategic tools to the contractors and subcontractors of the Army, Navy and Maritime Commission, and 25 percent to foreign purchasers and domestic essential industries—mainly the machine tool industry itself.

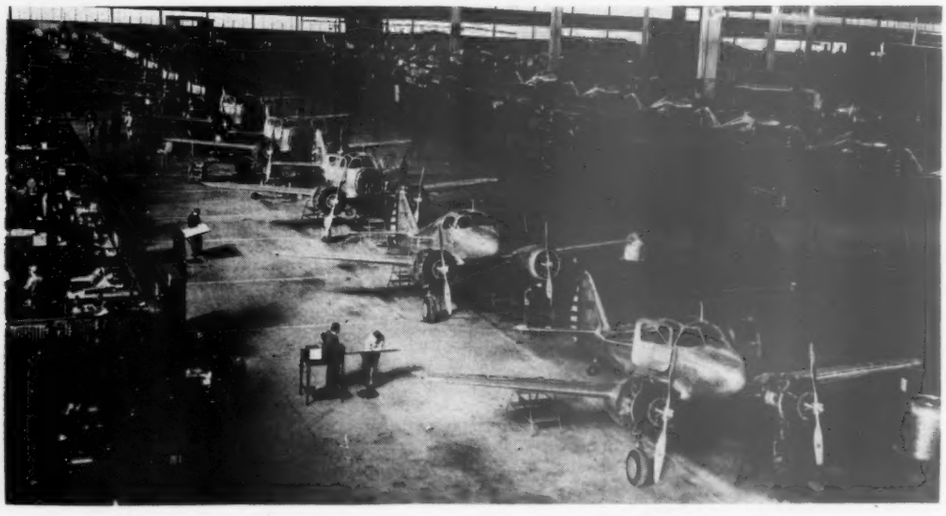
The Army, Navy, Maritime 75 percent group is divided into six sub-groups Bureau of Ships, Navy Ordnance, Army Ordnance, the two Air Services of Army and Navy, Miscellaneous, and Maritime Commission.

Every machine tool producer is ordered to schedule delivery of his products, by types and sizes, on a percentage basis, to these groups and to the 25 percent group. The tools themselves are divided into two groups—1 and 2. Existing orders for Group 1 remain undisturbed until June 1 and for Group 2 until July 1.

On those dates, orders on hand for these groups are scheduled three months in advance. After that, orders are scheduled a month in advance at a time, so that all are always three months ahead. Thus, the machine tool user always knows when he is going to get his deliveries.

In addition to the percentage allocations, the sequence of deliveries is affected by the purchaser's preference ratings, his "urgency standing" on the numerical master preference list, and by the delivery dates called for.

The order is extremely complicated as written and every user of machine tools should study its detail.



MASS PRODUCTION FOR MASS BOMBER TRAINING

Twin-engine Curtiss AT-9 advanced trainers roll to completion along assembly lines in huge new Curtiss-Wright plant "somewhere inland." Being delivered to the Army Air Forces in growing numbers these planes, because their flying characteristics are similar to those of high speed, multi-engine bombers, are used during transitional training period. Each plane carries an automatic pilot.

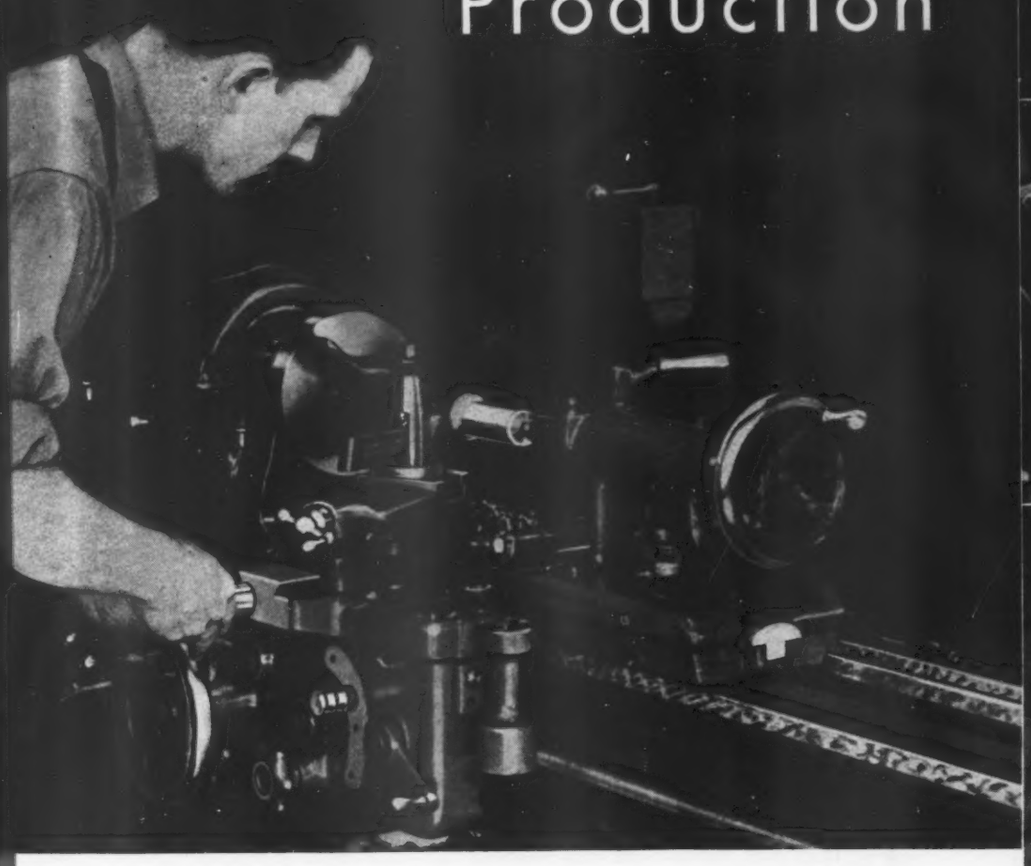
FDR Orders Navy to Take Aircraft Plant

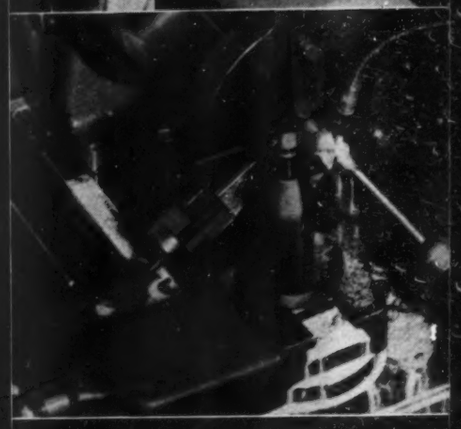
The President recently ordered the Navy to take over and operate three plants of the Brewster Aeronautical Corp. White House Secretary Steve Early said the action was taken because of "dissatisfaction with the management." He said he didn't think there was any labor trouble.

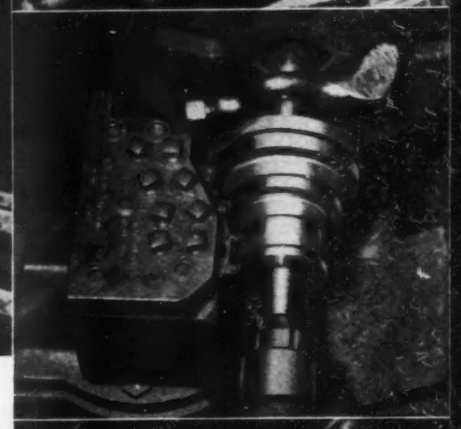
A Navy statement said Brewster held contracts for combat planes "the orderly and regular delivery of which is essential to the war effort." The statement said the firm's existing private control "has not proved adequate . . . effectively to operate the corporation's plants so as to assure these essential deliveries."

Aircraft men in Washington said that a contributing cause of the plant seizure was delay in delivery of certain types of combat planes from other sources.

for Efficient Production







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EQUALLY EFFICIENT on precision toolroom work or close tolerance manufacturing operations, South Bend Lathes will help solve your production problems. Hundreds of nationally known manufacturers select them when streamlining their shop equipment to meet present day needs. Substantial savings in capital investment, power consumption, floor space and labor costs have resulted from their installation. They will give you the same efficient, trouble-free service they are giving in the shops of some of the largest defense industries, the Army, and the Navy.

Many features contribute to the efficiency of South Bend Lathes. A wide range of spindle speeds permits machining work with maximum cutting tool efficiency. Their versatility reduces set-up time to a minimum — lowers cost of change-over from one job to another. Smooth, vibration-free operation permits finish turning or boring with such precision that subsequent grinding, honing or lapping operations can often be eliminated. A convenient arrangement of controls makes for an ease of operation which reduces fatigue and lowers the possibility of error.

Maximum production at minimum cost can be attained only when the lathe is matched perfectly with the job. Made in a wide range of sizes and types, there is a South Bend Lathe that will efficiently handle almost any class of lathe work. Write for catalog and name of dealer nearest you.

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IMAGINEERING: GETTING OUT OF THE GROOVE

THESE FOUR YOUNG WOMEN, so earnestly mastering the art of torch-welding aluminum, suggest that someone, somewhere, has checked out of the groove and started some practical Imagineering.

THEY PROVE what we've been saying for years: Alcoa Aluminum is easy to fabricate. The man who started the school where these girls are learning, and graduating to war jobs, simply had imagination enough to believe that

easy really means *easy*. Then he did something about it!

IMAGINEERING is letting your imagination soar and then engineering it down to earth. It is ingenuity in modern dress.

IT IS THE THING that has enabled the aluminum industry to keep on top of a plane schedule, increased tremendously in numbers, but also calling for almost twice as much aluminum per plane as the average plane needed two years ago.

IT IS WHAT EVERY ONE OF YOU are doing on your war job. Simplification, standardization, training. New methods, new materials, new records.

THIS WAR is showing Americans what they really can do if they try.

LET'S MAKE a vow to carry this same spirit over into postwar America. We'll all have the skills, the habit of work, the thrill of doing. There will be lots of aluminum to make into better products than peacetime America ever knew. It will be a great day for Imagineers.

Aluminum Company of America, 2182 Gulf Building, Pittsburgh, Pennsylvania.

★ SO MUCH SO SOON ★

ALCOA ALUMINUM

Aircraft Industry Goes Under PRP Plan
Hope Schedule Supplies 1 Year Ahead

Washington (AVIATION Bureau)—The aircraft industry is credited in Washington with fine progress in adapting itself to the War Production Board's Production Requirements Plan. PRP is a method in the priorities system under which war production companies apply for ratings on materials three months ahead, based on past three months requirements.

The aircraft industry has been under a blanket rating system, under which applications for ratings were made on form P-109. WPB recently sent out a letter terminating the use of this form as of June 30, and asked the industry to get under the PRP plan by same date. Aircraft manufacturers were asked to get their PRP applications in on form PD-25-a by June 5.

East, west, and central district procurement committees have held meetings, and worked out the elimination of some classification data usually required under PRP, and standardized other data—on purchased parts and materials.

Aircraft industry is hoping to make applications for a year in advance instead of three months. It can do this because its company programs are scheduled much farther ahead than are those of many other war industries. In fact, some aircraft production schedules are worked out for as late as 1944.

Estimates of requirements for one year in advance will give the board a chance to expand production of materials and parts wanted, or figure out substitutions, rather than cut somebody else off. The aircraft industry hopes that all PRP production can be brought to a six-month advance basis.

The War Production Board is pleased with the cooperation of aviation in the PRP program. Much credit is due to the Aero Chamber for work done.

NAVY "E" TO NORDEN BOMBSIGHT PLANT

James V. Forrestal, Undersecretary of the Navy, pins the Navy "E" insignia on Dorothy Meyer, employee of the Norden Co., recipient of the coveted award for excellence in production of the famous bombsight. Two other employees await their pins.

Billions for Planes

War funds made available by Congress or the RFC since June, 1940, totaled $162,416,000,000. The most important item is $8,861,000,000 for construction of airplanes. Appropriations made available from June, 1940 to March, 1942, total $26,796,000,000; the Sixth Supplemental War Appropriation 761,000,000 making a grand total of $35,557,000,000 for aircraft, which amounts to 23 percent of the complete war funds.

Aircraft Builders Salvage Metals

Scrap salvage by America's aircraft plants will furnish enough aluminum to build 250 *Flying Fortresses*, enough magnesium for 500,000 incendiary bombs a month. Boeing's scrap pile is turning back over a million dollars worth of materials a year. In each shop a man is assigned to picking up all scrap, and into "trash" bins go aluminum, stainless steel and plain steel scrap. Borings or metal "sawdust" are swept up and sifted. The larger material is sold; aluminum is returned to its producers who remelt and reroll it.

Aluminum alloy tubing, valuable for its magnesium alloy, strips of sheet metal from the punch presses, brass borings, and kirksite turnings, are taken to a smelter which removes steel content and returns them in the form of ingots. Nothing escapes the salvage list at Boeing's plants; rubber, bolts, nuts, burlap, weather stripping and paper are only a few items collected. Old rags now go to the laundry, are washed and returned. WPB rates each plant by the percentage of segregation. Boeing's percentage for March, listed at 95.38, rates at the top of WPB's scale.

The Wright Aeronautical Corporation is salvaging metals which are sent to steel companies, shipyards and tank manufacturers, as well as to smelters. Collection bins have been attached to all machine tools to catch and hold shavings and chips. Scrap is collected by men assigned to pick up only certain metals, eliminating the waste that would result from mixing metals. Wright's salvage list includes copper, beryllium bronze, phosphor bronze, aluminum bronze, brass and cutting oil.

Residents of the Veterans' Administration Facility in Los Angeles, are doing their bit by segregating mixed nuts and bolts used in airplane plants of North American Aviation.

These are examples of salvage programs now working in nearly all the major aircraft factories.

Mars Flys Again

Largest air vessel in the world, Martin's *Mars*, will fly sometime this month. Normal crew is eleven men. The cabin contains 2,175 cu.ft. of space. From the bridge a staircase leads up to a door high in the cabin. Through this door, mechanics enter the wings to service the four 2,000-hp. engines. Each engine has a room where a mechanic may sit and watch the performance.

Twenty-four telephone stations are spotted over the ship. Auxiliary engines drive generators supplying electricity for lighting, ventilation, communications, cooking and the power-operated devices. A light touch on the wheel and rudder pedals is obtained from powered controls. The captain even has a private stateroom. The *Mars* was put out of commission some time ago by an engine fire which started when a propeller broke during a test run on the water.

50c. Wage Increase

The Department of Labor has extended the definition of the Aircraft Manufacturing Industry, under the Public Contracts law. It will include: light commercial aircraft; engines and propellers for light commercial aircraft; parts and accessories for light commercial aircraft and their engines and propellers; gliders; and specialized servicing equipment for ground use. Prevailing minimum wage for employees engaged in the manufacture or furnishing of such products is 50c per hour.

IN AIR 100 DAYS AHEAD OF SCHEDULE

First B-24 land bomber to roll from assembly line of Consolidated Aircraft's new plant "somewhere in the southwest" takes off on initial test flight 100 days ahead of production schedule. George J. Newman, vice-president in charge of plant, was at controls of the plane, first of a new series with speed above 300 mph. range in excess of 3,000 mi. and bomb load of more than four tons.

Safety for Workers

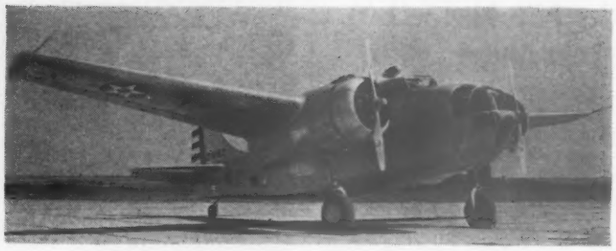
Aircraft companies have embarked on a campaign to make their employees "safety-conscious." Rules and regulations for safeguarding health and welfare have been laid down in every aircraft plant. Safety committees and councils have been appointed in each factory to meet and discuss unsafe conditions and offer suggestions for improvement. First-aid drills and safety classes are required courses for new employees in almost every plant.

Northrop has safety representatives, wearing green and white arm bands, stationed about the plant. Douglas and other companies have trained safety engineers and volunteer employee inspectors in every department.

Companies employing women, like Vultee and Vega, require them to wear hairnets or snoods at all times. The rule applies especially to women working as machine operators or adjacent to them.

North American and others have been supplying high-potency vitamin pills to their employees. These pills, containing a high A, B, D and G content, reduce fatigue and increase efficiency.

Most of the companies have individual safety awards and trophies which are given each month to the department with the best safety record.



BOEING'S WOOD, METAL AND FABRIC TRAINER

Boeing Wichita's new twin-engine plane is designed to train a medium or heavy bomber crew together, as a crew, after the radio man, navigator, bombardier and pilot have had their individual training. Nose has places for student bombardier and instructor.

American Central Mfg. Co., formerly Auburn Central Mfg. Co., recently declared a dividend of 35c. a share—the first common payment since reorganization of the concern in May, 1940. Slightly more than 50 percent of both the preferred and common stocks is owned by the Aviation Corp.

ASSEMBLY LINES . . . By Dorsey Adams

Wage increases totaling $1,000,000 a year were given employees of a Curtiss-Wright Corp. Missouri plant, as a result of contract bargaining negotiations between the plant management and the International Association of Machinists. The AFL union was the bargaining agent for the entire plant. Time and a half pay for Saturday and double time for Sunday and holiday work, amounts to about 5c. an hour increase per workers.

Broadened production facilities at the Libby-Owens-Ford Glass Company makes it possible for them to fabricate Plexiglas transparent plastic parts for aircraft, under an agency agreement with Rohm & Haas Company, chemical manufacturers. Fabrication work will start soon with R. G. Milroy to supervise Plexiglas marketing. In its new arrangement, company now is better able to lend technical assistance of greater scope in the use of all types of flat and bent safety glass, together with formed and flat Plexiglas plastic.

Purchase of the Ford Motor Company plant in the Mississippi Valley by the Defense Plant Corp., has been negotiated and the plant has been leased to the Solar Aircraft Company. Solar's new midwest plant will operate as a branch of the main factory, under the direct supervision of D. M. Miller, vice-president and operations manager. Production is scheduled for the first of July.

A plane every eight minutes (60,000 this year) is the basis of Goodyear's promotion program at its plant. Goodyear's aircraft and parts plant has organized a campaign, under the direction of a joint labor-management production committee, to bring the war close to the workers. Behind the 8-ball — is the company's theme. All through the plant the "8-ball" appears. Workers voluntarily signed cards pledging cooperation toward a plane each eight minutes—the national production rate necessary to provide the 60,000 planes called for in 1942.

Fifteen thousand dollars was presented to the Navy by the Electric Development Company. The check represented a three-shift Sunday's work at time and a half, contributed by employees, and the management added enough to the $7,391.97 thus raised to make the total a round $15,000. Rear Admiral Joseph W. Defrees, USN, accepted the check. We hope to hear what the Navy did with the money.

A large demand for training ships is anticipated by Aeronca Aircraft, from the CPTP greatly expanded training plan, the CAP, and from the various South American countries now requesting our support in setting up training programs in their countries to be sponsored under the Lend-Lease program. Aeronca expects 1942 to set a new high for the use of light airplanes.

Packard Motor Car Company is putting into shop operation its program of the Donald M. Nelson war production type, for accelerating its 100 percent production of wartime assignments. The management-labor committee is appointed and fully functioning and the plan bears approval of company and union, between whom it was developed. Included in the program are three main divisions of activity: promotional publicity to shop workers including a voluntary "best effort" pledge card and pin; recognition awards for outstanding production achievements and suggestions; and a school for training unskilled workers. Purpose is to increase workers' interest and pride in their jobs.

A crew of mechanics specially trained to keep flying every plane delivered to the Army is the goal of aircraft manufacturers and the Army Air Forces in a joint program to train ground men and mechanics in maintenance methods. Groups of maintenance personnel with only basic training are being sent from Army air bases to airplane and engine plants for intensive schooling by experts in actual service problems and techniques.

An agreement between management and the Union, of Solar Aircraft Co., has been reached. It is the first War Labor Agreement negotiated in the aircraft industry in southern California since Pearl Sunday, the company says. There will be neither strikes nor lockouts. Any dispute between the management and the Union will be settled by arbitration, and the decision of the arbitration board will be final, binding, and conclusive upon all parties concerned. The agreement expires 90 days after the armistice.

The only American designed and built liquid-cooled engine now being used in Allied Air Forces has performed "absolutely amazingly under the most gruelling wartime fighting conditions," says Brig.-Gen. C. D. Chennault in a cable from Burma to workmen in the Allison Division of General Motors. Gen, Chennault commands the American Volunteer Group which felled more than 200 Japanese planes with its Curtiss P-40 planes. He further adds that this record has been made without losing a pilot or airplane due to engine failure.

Active mining of domestic bauxite has been started by a subsidiary of the Reynolds Metals Co. Bauxite from Arkansas deposits, mined by the Reynolds Ore Co., will be shipped to the aluminum plant to be turned into the light weight metal. Original shipments came from the Netherlands East Indies. During the past fall the company made contracts from Surinam, Netherlands colony in Central America. Using bauxite from domestic sources releases ships that otherwise would be required to bring this mineral, and cuts down the length of rail haul.

The firm representing Kinner in Argentina and Brazil, the Tri American Aviation, Inc., says many engines have had thousands of hours and are still giving excellent service. The Argentine Department of Civil Aeronautics has approximately 35 Kinner-powered Fleets which it has distributed among government sponsored, subsidized aero clubs for training student fliers. Argentina built up a large reserve of Kinner spare parts and, with replacements of about 35 percent, is in a position to keep its Kinners in service. In Brazil Kinner-powered Fleets are used for the army's primary training program.

Eddie Ainsmith, who caught the fireball of baseball's immortal Walter Johnson for ten years, has joined Republic Aviation as athletic director. He will develop a program designed to give all Republic employees — including the women—a chance to participate in some sport.

HERE'S A TRACING CLOTH
proofed against
MOISTURE GHOSTS

Perspiration stains and water marks hold no terrors for this improved tracing cloth—*and it holds pencil smudges or erasure scars at a minimum.* Now you can have clean tracings, in pencil or ink, free from these untidy "ghosts" that reproduce on blueprints!

The secret of this amazing performance lies in a remarkable new process that defies moisture, and gives PHOENIX an unusually durable working surface. You can use harder pencils with this improved cloth and get sharper lines with less tendency to smudge. Even 6H pencil lines show clearly, and reproduce strongly! Erasing does not mar the drawing surface; erased areas take pencil smoothly—and ink without feathering. The new white color and increased transparency provide excellent drawing contrast and produce strong blueprints.

Let PHOENIX speak for itself on your own drawing board. See your K&E dealer, or write for a generous working sample and an illustrated brochure.

PHOENIX DEFIES MOISTURE GHOSTS

Your hands are never dry. Perspiration stains ordinary tracing cloth, producing opaque spots, or "ghosts," that show on blueprints. Water splashes make even more disagreeable stains.

PHOENIX *Tracing Cloth withstands actual immersion in water for more than 10 minutes at a time without ill effects!* Perspiration will not stain it!

PHOENIX LESSENS SMUDGE GHOSTS

The improved surface of PHOENIX Tracing Cloth permits you to use harder pencils (5H and 6H) and to get sharper lines with less tendency to smudge.

Result: Cleaner tracings and blueprints.

PHOENIX REDUCES ERASURE GHOSTS

Ordinary tracing cloths become scarred when erased. Erased spots produce ghosts on the blueprints.

PHOENIX has a durable drawing surface that reduces working scars to a minimum.

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TRACING CLOTH
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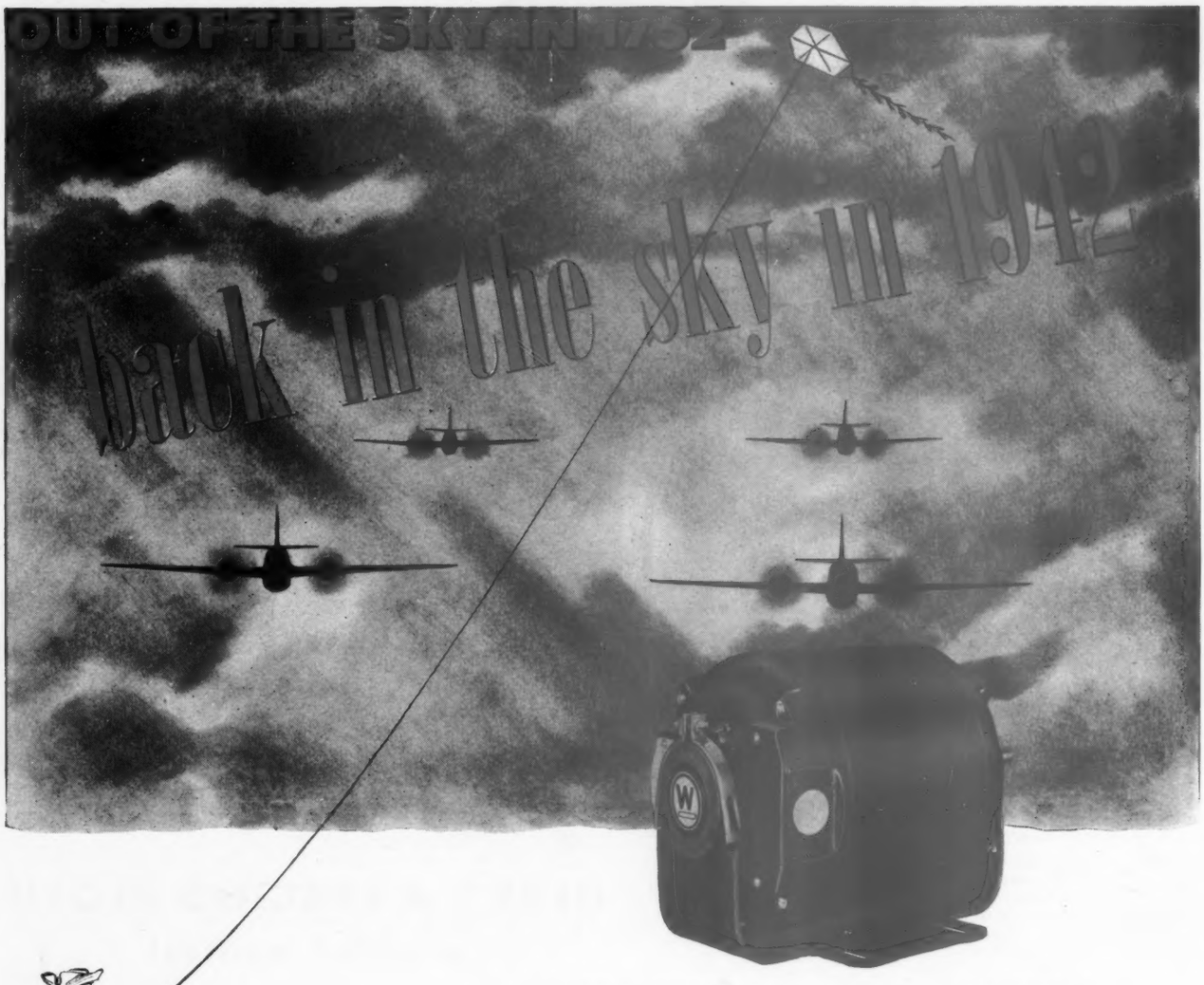

Franklin was jubilant that sultry afternoon in 1752 when sparks crackled from the key on his kite string. He had drawn electricity from the sky.

Today, Westinghouse is putting electricity back in the sky, harnessed and directed to do many important jobs in America's hard hitting war kites.

Into the air with the ever-increasing number of fighters and bombers go powerful little generators which produce electricity, and auxiliary motors, control equipment, dynamotors and other Westinghouse products which use it.

These are being built by the thousands, with the same precision and experienced skill used in building small motors for such peacetime products as washing machines, ironers, stokers and gasoline pumps.

If you have problems on rotating electrical equipment for airplanes, Westinghouse production facilities, designing skill and engineering experience can help you solve them. Write Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N.

J-03172

Westinghouse SMALL MOTOR DIVISION

News Notes From Britain

By GEORGE ABRAHAMSON

London (Special to AVIATION)—**Official figures of British aviation since 1940** were given by Capt. Harold Balfour, Under-Secretary of State for Air. In 1940, 5,500,000 mi. were flown by the British Overseas Airways Corporation in aid of the war effort; in 1941 there was an increase; and in 1942 the figure will be about 8,000,000 mi. Two Short G-class flying boats taken over by the Air Ministry at the beginning of the war were returned toward the end of last year. One of them, with accommodation for about 40 passengers, is now flying to and from Lisbon; the other one will be soon.

The Airgraph Service, introduced with outstanding success for mail of British forces in the Middle East, has been extended to civilian mail from East Africa to Great Britain. Hitherto air mail from Kenya went by air to South Africa and thence by sea to England. The new service which saves cargo space by carriage of micro-photographic copies of the air mail letters will speed up communications a great deal; shortly it will be available in the opposite direction. Air mail will also be resumed between England and Sweden, but postage will be 1s. 3d. per half ounce (as on the North Atlantic route) instead of 2½d. charged for all letters before the war. "Present circumstances preclude any statement concerning the route by which the mail will be flown," but that there is a northern service of British Airways has been known for several months.

Britain's largest underground aircraft factory has begun operations and will be in full production on engines, components and accessories by August, giving employment to 14,000 workers in two shifts of ten hours. Situated in an unused quarry from which a million tons of stone had still to be cleared, this underground aircraft factory which is only one of a number building or built is equipped with three sources of fluorescent light, its own artesian well and water reservoir, five air intakes and five exhaust shafts of 20 ft. diameter, eight passenger lifts for 50 persons each, and a machine hoist and shaft for pieces up to 20 tons. The total cost of the factory which is approximately three-quarters of a mile square is about £5,500,000. Buildings on the surface include six hostels, each accommodating 1,000 persons, communal restaurants, shops, a cinema and other adjuncts of a self-contained community. Experience in underground aircraft factories completed earlier shows the rate of illness among workers to be low.

Details of the Westland Whirlwind, British single-seat twin-engine fighter, for nearly two years in service but all this time kept on the secret list, have now been published. The machine is 32¼ ft. long and 10½ ft. high, the wing span is 45 ft. Four 20 mm. shell-firing guns are mounted.

The German aircraft industry moves east, and new plant and extensions are reported from various centers in Austria, Bohemia, Moravia, and Pomerania. Most of the new plants are built by well-known firms domiciled in western and central provinces of Germany which prefer the safety from air raids in the east even though materials and skilled labor are easier to procure in the old industrial districts. The movement to the east finds a counterpart in transfer of orders for components to the occupied countries of the west. The Dutch firm of Fokkers is reported to operate plants in Belgium and France, and several French aluminum producers have extended their works to meet German orders for light metal.

Crankshaft bearings using synthetic resins are an industrial possibility, according to German experiments, if a new manufacturing method is used. Resin-impregnated tissues (linen, asbestos, glass wool) in thin layers of 1/12 in. were wound round the metal part, secured to the metal surface by pressure, and subjected to a hardening process. The pressed resin bearings are inferior to lead bronze and light metal bearings, even if suitably formed, in heat and tear resistance, but superior by absence of corrosion, constant surface hardness from — 180 to + 135 deg. C., and high adsorption of oil and fat molecules. Experiments on several types of engine crankshafts with 2,200 rpm. and for slide bearings are claimed to have been very satisfactory.

The Focke-Wulf Fw 190, Germany's new single-seat fighter, first encountered in combat last fall, can also be described

ON SCHEDULE . . . by "Vista"

Germany is making various frantic efforts to increase her airplane production, realizing that American plane plants have already caught up with her peak in 1941, and are now well on the way to building more planes than the whole Axis put together. Most of these frantic efforts have been the jailing or shooting of Germany's airplane plant managers, who were summarily ordered to meet America's tide with poor materials, worn out machines and men who have nothing to fight for.

The Nazi's peak, around July 1941, is generally said to have been some 3,500 planes per month, but the constant deterioration of plants and labor have reduced this to about 2,700, with the index still going down, as they try to match British and American products. To this trickle can be added some 600 Italian planes (mostly for training and an occasional flight of the Duce), and probably another 600 for Japan, or a grand total of perhaps 4,000 per month.

England and Canada, together with Australia, are now producing well over 3,000 per month, Russia is adding another 3,000 to the growing forces, and America, admittedly a late starter in the race, is running slightly ahead of schedule for this year's 60,000 planes.

The German output will also feel the effects of some of the latest bombings, which at last are on a scale where they have a lasting effect, while the retooling for such planes as the Focke Wulf Fw 190, now replacing the obsolete 109-F's and G's, and Blohm and Voss' "asymmetrical" plane, of doubtful value, cannot have helped.

All in all, the plane production picture is very happy for the United Nations, who with undoubted air superiority for the first time since 1939, can repay damage with interest.

Events have moved so fast in the past months, that matters not directly concerning the immediate future are soon out of sight and out of mind. Yet these months have forced one of the world's best-run private airlines out of existence, as was its sister company before it, by the same fate. This may not be the time for a complete review of the history of the KNILM, or Royal Netherlands' Indies Airways, but a few words will bring back to memory the brilliant job this line has done, pioneering in the East Indian area. The company got its start in 1928, and with the help of its sister organization in the homeland, the KLM, made the first regular passenger flight on May 1. Enthusiasm and criticism, mostly uncalled for, was rampant in those days, but the minor problems, mainly arising from difficulties with jungle airports and tropical flight conditions, never before tried out, were soon ironed out. While the first airnet totaled about 400 miles, the Jap invasion found a network spreading through the 20,000 islands in the area, connecting all the vital points with the most modern equipment available, on regular schedules. During the first years, the phenomenal success of the KLM line to Java helped the KNILM gain in popularity, and the government soon began taking a greater and greater interest in the company's management, in later years making many extensions possible by the construction of airfields and a liberal subsidy. In 1938, the first extension to another continent came about, when the KNILM, locked in a bitter fight with the KLM, mainly about the latter's Australian plans and growing influence, joined in establishing the Java-Sydney branch of the Intercontinental Airways, under which name the London-Sydney line was run for a little while. Since then, other extensions have been added, mainly to Singapore and Saigon, with the prospect of a route to Manila. When Holland and its Colonies are once again in rightful hands, the KNILM, and the KLM, must again take their place in world air transport, reestablishing the vital lines they were forced to abandon, but this time not with constant friction, but with real cooperation.

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now. It has attracted some interest because it differs in design from other German types. With a span of 37 ft. it has a wing area of 194 sq.ft. Its length is 29 ft., loaded weight 7,000 lb., service ceiling 38,000 ft. Top speed is estimated at 370 mph., and action range 525 mi. at 300 mph. The engine is an 1600 hp. BMW 801 14-cylinder two-row radial engine with fully enclosed cowling and fan-assisted aircooling. The shallow cockpit is protected by a completely transparent hooding giving the pilot a good field of view. Armament seems to consist of six machine-guns in the wings.

Canadian News

By JAMES MONTAGNES

Toronto, Can. (special to AVIATION) — Trans - Canada Airlines, the publicly operated transcontinental service, will extend its service to Alaska as soon as six new airplanes can be obtained from the United States, H. J. Symington, president, told the railway and transport committee of the Canadian House of Commons at Ottawa on April 30. Mr. Symington told the committee that the policy upon which TCA operates is to provide a main line standard on all services. Branch line services which could not be up to main line standards were left to private enterprise. He said he favored setting up a reserve to avoid going to the government for money to meet necessary expansion. A cut in postal rates from 60c. to 45c. a mile for air mail was announced, the cut being asked by the government because of war conditions, ending in three years instead of five, a period in which the postoffice was to subsidize the TCA. The postoffice is now making a profit from air mail, it was reported by Munitions and Supply Minister C. D. Howe, who also has charge of civil aviation.

Officials have been appointed by the recently formed Canadian Pacific Airlines Ltd., by L. B. Unwin, president, at Montreal. The company, made up of amalgamated northern bush lines, is using the men who ran the individual companies as operating officials. C. H. "Punch" Dickins, D.F.C., O.B.E., has been named vice-president and general manager. He served in the First World War, was with Canadian Airways Ltd., and operated the Royal Air Force Ferry Command at Montreal before the RAF took it over last year. He will headquarter at the Canadian Pacific Railway offices in Montreal.

G. W. G. McConachie, former organizer and president of Yukon Southern Transport of Edmonton, is appointed general manager of the western division, with headquarters at Winnipeg.

C. R. Troup is general supervisor of schools and T. W. Siers, 1941 McKee Trophy winner, is general superintendent of repair plants, both operated for the airline as well as for training and repairing warbirds and air force equipment. Both will headquarter at Montreal.

W. R. Patterson, assistant comptroller of the Canadian Pacific Railway is appointed comptroller for the airline, and T. H. Moffitt as treasurer.

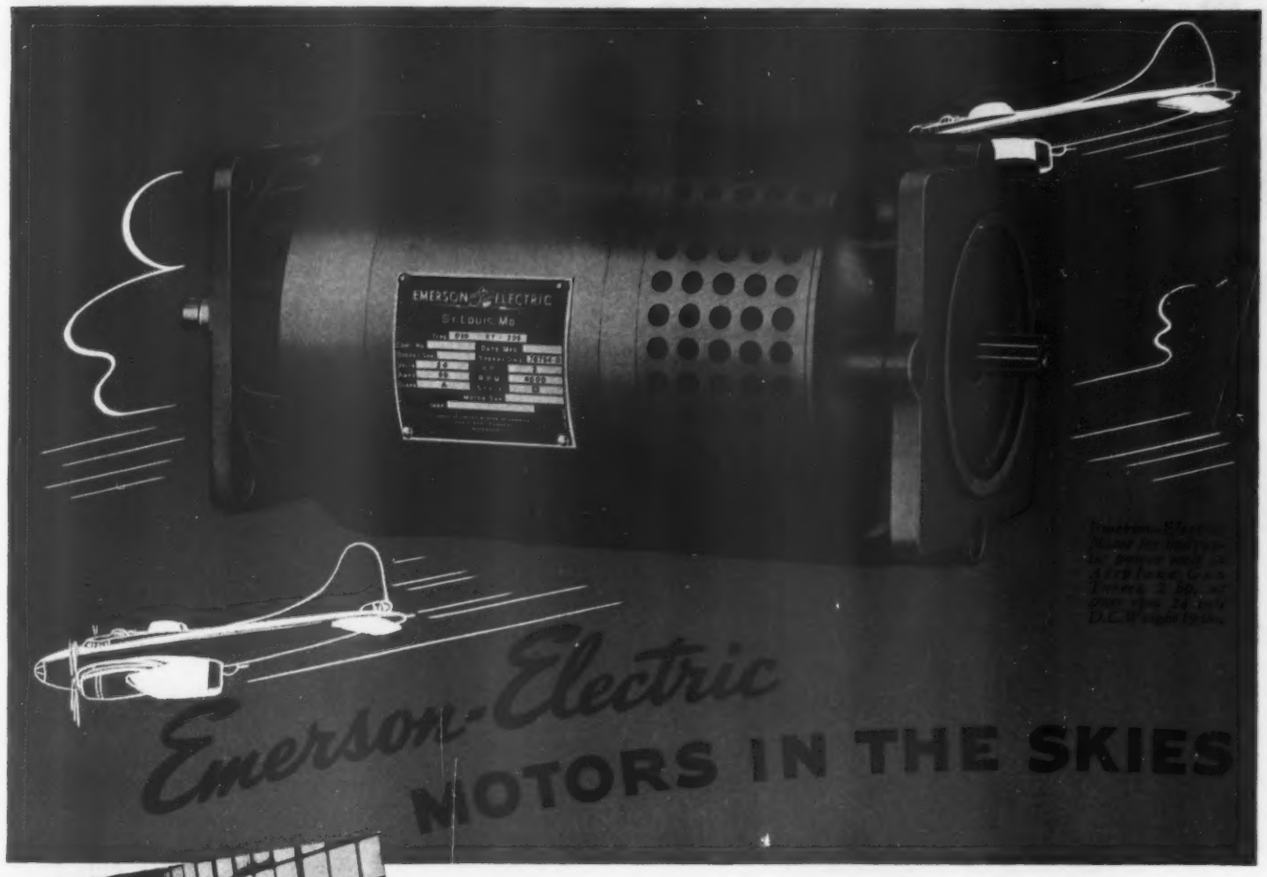
Canada now has 18 low pressure chambers for training aircrew in the Royal Canadian Air Force, according to an announcement of the Department of Munitions and Supply, Ottawa. Twelve of these "cold rooms" were purchased in April for installation at strategic points in connection with the British Commonwealth Air Training Plan. These pressure chambers simulate conditions at high altitudes and are used primarily to determine the reactions of men and equipment under these conditions, the temperatures varying from normal to 70 deg. below zero Fahrenheit.

Annual reports of Canadian aviation companies reveal that:

Boeing Aircraft of Canada, Vancouver, has orders on hand for more than 30 million dollars. The company is producing PBY flying boats, employs more than 3,000 men and women, and last year had a net profit of $72,798.

Noorduyn Aviation Ltd., Montreal, has a backlog of orders totaling 36.6 millions, last year delivered aircraft and parts valued at 9.7 millions, employed 5,000 persons, and had manufacturing floor space at the beginning of this year of 495,000 sq.ft.

Fleet Aircraft Ltd., Fort Erie, Ont., reports a 1941 net profit of $185,381. The company's plant was fully employed throughout the year in the manufacture of airframes and spare parts and the overhaul of various types of aircraft and air engines. Now all overhaul operations are centralized in a specially built plant, leaving the main plant available for the manufacture of a new type of aircraft in substantial quantities. The new plane, Fairchild *Freshman*, has been picked by the Royal Canadian Air Force, to succeed biplane Fleets and de Havilland *Moths* for elementary training. The *Freshman* has been used successfully by the Royal Norwegian Air Force training in Canada.



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CAB Orders New Sliding Mail Pay Scale Say Public, PO and Lines Will Benefit

Washington (AVIATION Bureau)—An automatic air carriers' mail pay rate has been devised and put into effect by the Civil Aeronautics Board, which will spread the mail load over additional schedules rather than concentrate it on a limited number of trips.

All of the carriers are covered by the new order except American Airlines and Continental Air Lines; these two recently had been placed under similar mail pay plans.

Institution of the automatic mail pay scale had no connection with reduction of equipment under Army charter contracts.

Heretofore mail has been flown on only certain schedules with a specific rate of pay per air mail mile. The board's order fixes the rates per mile on a sliding scale, permitting the use of additional trips, in a way which will not materially change the total compensation to the various carriers.

The carriers will benefit by the new order, in many instances. Under the old system, often it was necessary for them to displace passengers in order to make room for heavy mail loads. The public will benefit by having more frequent air mail deliveries. Also, of benefit to the postal service will be the availability of second or extra sections for the transportation of mail.

The board emphasizes in its order that there is no attempt to make findings of fair and reasonable rates, or to increase or decrease the compensation of individual operators.

If the average daily designated mileage is increased to any company (through additional trips used by the PO) the rate is proportionately decreased so that the total compensation remains approximately constant. Possible lessening of excess poundage revenues resulting from spreading loads over additional schedules under the old system, is compensated for in much the same way.

Since the contract carriage of air mail began in 1926, there have been many systems of compensating the lines. This newest one, which is welcomed by the Post Office, is still not the last. Changes will come, but the principle of most frequent service probably will stand indefinitely, until all first class mail is carried by air.

Dr. Edward P. Warner, member of CAB, is credited with major contributions to the new air mail pay system.

West Coast Pickup

Looks as if a grid of mail pickup routes will cover all populous regions of the country after the war. The glide, drop and snatch mail system, as demonstrated by du Pont's All-American company during the last few years, is a complete success. Four companies have applied for pickup certificates on the Coast: West Coast Airlines, Southwest Airways Company, Western Air Lines, and United Air Lines. One of them applied first, the others intervened, and now they are all applicants. Several other applications for pickup systems are pending. It is anybody's opinion whether they could get enough airplanes to operate if approved.

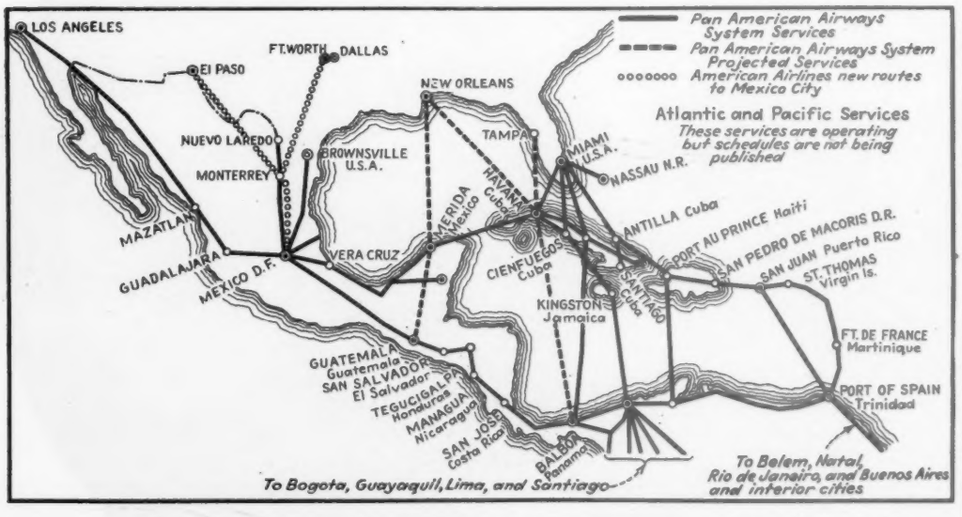
Panagra Has 7-day Pacific Coast Schedule PAA Inter-American Operation Up 50 Percent

Resulting from the change-over of hemisphere industry to a war basis, and to accommodate traffic which cannot proceed by sea because of the withdrawal of passenger steamships for war needs, Pan American-Grace announced a sixth weekly service on the South American Pacific Coast. In the near future a seventh service will be inaugurated, placing the operations of this line on a daily basis.

Pan American Airways are increasing the 4-engine *Clipper* service across the Caribbean Sea between Miami, Florida, and the Panama Canal Zone. Addition of the new service will bring to 28 the number of weekly schedules between the United States and this point of hemisphere defense. Increased schedules will provide daily service along the Atlantic from the tip of Florida to Rio de Janeiro and on to Buenos Aires.

The bulk of all Inter-American mail, passenger and express traffic is now routed by air because of surface ship curtailment. At the rate of over 1,000,000 mi. a month PAA is making scores of flights each week between North and South America and more than 100 flights weekly within Central and South America, maintaining over 100 planes in the air practically every hour of the day over intra-hemisphere routes. Passengers increased since we went to war from 11,000 to 26,000 monthly. Mail and express cargo is now 750,000 lb. a month.

Routes of the PAA system and its associated nationalized airlines in Mexico, Cuba, Colombia, Brazil and Bolivia have been extended to replace 30,000 mi. of air routes formerly controlled by the Axis. To clear foreign elements from South American air transport fields, United States services have increased their operating route mileage from 37,000 mi. to over 57,000 mi.



AERIAL GATEWAYS TO LATIN AMERICA

Here are shown eight air gateways to the good neighbors south of the border. Up until April 18, there were six Pan American-operated and projected air services out of U. S. points to Mexico, the Caribbean, and South America: namely, Miami, Tampa, New Orleans, Brownsville, Corpus Christi, and Los Angeles. On that date, the Civil Aeronautics Board granted a certificate to American Airlines authorizing the establishment of services from Ft. Worth-Dallas and El Paso, Tex., converging at Monterey, Mexico, thence to Mexico City.

That makes eight American places of departure and arrival between us and the Latin countries.

A. N. Kemp, president of American Airlines says: "We stand ready to proceed immediately in the performance of our obligations to these two governments," meaning the U. S. and Mexico, which recently approved the concession to AA.

"We intend to start construction on the necessary airports and ground aid facilities immediately and hope to be conducting an international air service to Mexico City within approximately six months," he said. These new airlines are a part of new social and trade ties binding the western hemisphere togther in the common war cause. Still greater benefits for all will result from it after the war.

TCA To Newfoundland

Trans-Canada Airlines has begun a new scheduled commercial service to St. John's, Newfoundland, from Moncton, N. B. Moncton will be the only Canadian terminus, but enroute to Newfoundland, a stop will be made at Sydney, N. S. The first of two stops in Newfoundland will be Gander Lake and at St. John's.

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Corrosion and other moisture damage to vital parts, accessories and supplies during shipment or storage no longer slows up production in Victory-geared industries. This time-wasting hazard is being overcome by Protek-Sorb — the modern, fundamental way to prevent moisture damage.
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Engine parts, accessories, complete engines, finished tanks and planes are, right now, being given Protek-Sorb protection during storage or shipment. Any product, from the smallest vital part to the complete assembly, can be given modern, Protek-Sorb protection. Don't let time-wasting methods upset the Victory Campaign! Use Protek-Sorb—save time for yourself and your customers. It's an important issue.
How Protek-Sorb Cuts Assembly Time . . . Protek-Sorb is a chemically inert, non-reactive granular material, supplied in small cloth bags that are placed within the container with the product. By a physical phenomenon known as surface adsorption, it takes up more than 45% of its weight in moisture—reduces the relative humidity to far below the danger point, making slushing unnecessary. Thus, when there is no moisture present in the container—moisture damage cannot occur.
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The number of aircraft manufacturing companies voluntarily returning millions of dollars to the federal government on original contracts as a result of lower production costs is growing rapidly and now includes Bendix, $73,000,000; Continental Motors, $40,000,000; North American Aviation, $74,000,000; Sperry Corp., $100,000,000 and United Aircraft, $26,000,000. Additional large reductions are predicted for the near future as subcontractors of the primary aircraft concerns begin to make voluntary price reductions. In each case announced so far the savings for the American taxpayer have resulted from increased efficiency, plant economies and the improvements in methods that follow in the path of real mass production.

Last but not least of all the aircraft company annual reports to be issued for the year 1941 was the **Curtiss-Wright** statement showing sales higher than those of the entire industry in 1939, record earnings, and, as Guy Vaughan, president, described it, an elevenfold increase in production, sixfold gain in floor space and a sevenfold jump in number of employees since the pre-war year 1938. Mr. Vaughan called stockholders' attention to the need for conserving cash at this time in order to insure the future success of the company but added "it is very difficult to do this under the proposed procurement policy of the government and the tax program."

Practically all the worldwide air transport operations of **Pan American Airways** are devoted to the war effort, stockholders were advised in the annual report. Equally interesting was the disclosure that only 1.1 percent of the concern's gross revenue last year represented government subsidy. Since the war began flight operations over the Atlantic have more than doubled while Pacific operations are about equal to those in effect before Pearl Harbor, according to Juan T. Trippe, president.

In the study stage, according to West Coast advices, are merger proposals for uniting Consolidated Aircraft and Vultee Aircraft. Ever since Vultee acquired a 34 percent interest in the outstanding Consolidated common stock late in 1941 a closer affiliation between these large warplane producers has been expected. If consummated, the merger will represent the largest "get-together" in the aviation field since the Curtiss and Wright companies joined hands back in 1929. Proposals for the union will be sent to stockholders, it is understood, as soon as a fair basis on which to exchange present stocks for the joint organization can be worked out.

Goodyear Tire & Rubber Co. will soon be making completed airplanes. Already the company has become one of the country's leading suppliers of aircraft parts, making equipment for five aircraft producers. From a handful of employees 20 months ago the aircraft division in another few months will account for well over half the entire Goodyear personnel.

Fairchild Aviation is another company prepared through large scale operations to pass economies along to the government. James S. Ogsbury, president, recently told stockholders the government has been advised that where costs prove to be out of line with prices quoted the company expects to reduce future prices to adjust this condition. Directors have continued the policy of paying moderate dividends in order to conserve working capital.

Briggs Mfg. Co. is in full production on aircraft parts and other war contracts now on the books, sales volume should be more than double the best peacetime rate, according to company officials. Business this year will depend upon the speed of re-tooling and delivery of new machines but it looks already as if 1942 volume will run ahead of last year.

Aeronca Aircraft is continuing its extensive research program and will be in position to introduce several new type airplanes when hostilities cease, Carl Friedlander, president, told shareholders at the annual meeting. This year, he believes, will see a new high for the use of light planes because of demands from the civilian pilot training program, civil air patrol and South American needs.

The number of Grumman airplanes delivered in 1941, L. R. Grumman, president, reports, were more than all those shipped in the preceding four years while the number of planes scheduled for delivery this year is approximately four times the 1941 total. Production of amphibians for commercial and private use has been discontinued and the eastern aircraft division of General Motors Corp. will make certain Grumman models for the Navy.

Immediate dividend prospects for United Air Lines are not bright, according to W. A. Patterson, who recently advised stockholders that "our stock, I believe should be of interest chiefly to those not concerned with immediate income. We still have a long way to go." He expressed the opinion, however, that there would be a tremendous development of commercial aviation after the war.

Kellett Autogiro reports first quarter sales of $929,729, as against $228,315 in the first three months of 1941. The major portion of the company's business is subcontract work for prime aircraft contractors.

Square D Company's Kollsman Division will have a "greatly increased" capacity in the final half of 1942 through completion of an expansion program now in progress, according to F. W. Magin, president. Very

★ ★ ★ By RAYMOND HOADLEY ★ ★ ★

MASS PRODUCTION METHODS are cutting the cost of war goods and the aircraft industry has taken the lead in giving Uncle Sam the benefit of these savings. Five aircraft and accessory companies alone have voluntarily lopped $313,000,000 off the prices of war contracts in their hands—an amount $88,000,000 larger than the sales deliveries of the entire aircraft industry in 1939. A number of others are negotiating similar reductions at the present time. All of which shows that the aircraft industry is looking at war production from the long range view of keeping its capital intact rather than as a means of making a large profit.

Until Congress gets down to cases and passes the new tax legislation still pending in committee (and that may not be for another couple of months) there is no accurate way of forecasting the earnings outlook of the aircraft manufacturers this year. The usual table of first quarter earnings statements will be found on page 242, but we frankly admit to our readers that they don't mean very much this time. Taxes are a major charge against operating income these days and the 1942 normal corporate income tax and the excess profits tax rate is anyone's guess right now. The financial officers of a company naturally make the best estimates they can of probable 1942 taxes; probably no two of them follow the same method and most of them are likely to be too high or too low on their tax reserve guessing game, possibly to the tune of several million dollars in some cases. So be prepared for some adjustments in first quarter earnings later on.

Here is the way one of the largest companies feels about this 1942 earnings situation. Eugene Wilson, president of United Aircraft Corporation, recently warned stockholders at the annual meeting that the company's policy on limitations of profits, existing taxes, possibility of further legislation affecting profits and the necessity of building reserves for "going out" of war production foreshadowed earnings this year below those for either 1941 or 1940. Later United's board of directors declared a semiannual dividend of $1 a share instead of the $2 a share paid a year ago.

Meanwhile the quiet conversion of the domestic airlines to the war effort also is having a rather uncertain effect on the profitmaking outlook of this aviation group. First quarter operations of the lines showed large gains in earnings compared with the dismal showing most of them experienced in the corresponding period last year. Thus they were able to enter the second quarter without large March quarter losses to offset. So much so good. But a rather important percentage of the airline's operations will henceforth be for the government on a cost basis. Other factors which cloud the picture is the possibility, as one executive predicts, that all airline travel will be on a priority basis by late summer. And whereas passengers now account for 70 percent of total air mail revenue today, with air mail and express accounting for 30 percent, this relationship may be reversed shortly. In the meantime, the encouraging factor about the airline picture is the fact that rising operating costs are being offset due to the fact that each airplane revenue mile is turning in more operating revenues than was the case a year ago.

★ ★ ★ ★ ★ ★

substantial price reductions have been made on principal items made for the Army which were only partly reflected in the first quarter earnings.

Solar Aircraft has leased the Iowa plant of the Ford Motor Co., according to Edmund T. Price, president. This plant was recently sold by the Ford company to Defense Plant Corp., a subsidiary of the Reconstruction Finance Corporation.

Liberty Aircraft Products has paid in full the $1,000,000 short term note held by Phoenix Securities Corp. and due Sept. 12, 1942, according to Oliver Payne, chairman. The note was incurred when Liberty purchased 60 percent (121,097 shares) of the outstanding stock of Autocar Co. common stock last fall.

Aviation Corp. had an undistributed equity of 21c a share in the earnings of subsidiaries in the first quarter in addition to the net profit of 17c. a share reported for the period. The net profits shown reflected operations of Republic Aircraft Products, Lycoming and the Spencer Heater divisions while the undistributed equity was figured on Aviation's share of the earnings of Vultee Aircraft, New York Shipbuilding and Auburn Central Mfg. Co. The production of propellers by the wholly owned subsidiary, American Propeller Co., will not commence until later in the year.

Borg-Warner's aircraft divisions are "keeping pace with and just a little ahead of" the aviation industry as a whole, Charles S. Davis, president, recently informed stockholders. Pointing out that the company had never had outstanding bank loans, Mr. Davis warned stockholders "not to be alarmed if you note that we had borrowed money" due to the need for additional working capital.

Two more aircraft companies are making long-range plans by setting up reserves for future development and post-war readjustments. **Curtiss-Wright** set up a $7,230,000 reserve out of 1941 earnings for this purpose while **Fairchild Aviation** has set aside $600,000 out of current earnings.

Here and There . . . If the recently ordered mail rate reduction for **American Airlines** stands, the $349,392 profit reported for the first quarter of 1942 would turn into a net loss of $41,000 . . . The domestic airlines are equipped to transport 6,000 in 24 hr. in case of an emergency, one official has figured out. . . . **Curtiss-Wright** has instituted a policy of periodic physical examinations of all key men at company expense. . . . **Borg-Warner** is building two new government - financed plant additions. . . . War losses of **Pan American Airways** incurred on the Pacific bases and to flight equipment, amounting to $910,000, have been filed with the newly established War Damage Corp. . . . Net asset value of National Aviation Corp. (aviation investment trust) on March 31 totaled $13.75 a share against $14.38 at the end of 1941 . . . **Grumman** is expanding production by means of its "dispersal plan" through which complete departments are moved into leased buildings near the main plant. . . . **Transcontinental & Western Air** reported a 187 percent gain in express pound miles and a 64 percent rise in mail pound miles in the first quarter. . . . Production at the California and Kansas plants of **Aircraft Accessories** runs far ahead of a year ago and is accelerating each month, according to a company announcement. . . . **Noorduyn Aviation Ltd.** had bank loans of $1,425,000 outstanding at the end of 1941, all of which had been guaranteed by the Dominion of Canada. . . . Unfilled orders of the same company at that time totaled $36,600,000. . . . New directors of **Pennsylvania-Central Airlines** are Frederick R. Crawford, R. S. Richards, Capt. J. H. Carmichael, George R. Hann and Jean Cattier. . . . The March backlog of **Ex-Cell-O Aircraft** were at a new peak. . . . John W. Castles, director of **Glenn L. Martin Co.** joins our armed forces.

Current Earnings Reports

Company	Period	Net Profits 1942	Net Profits 1941	Profits Per Share 1942	Profits Per Share 1941	Sales 1942	Sales 1941
Aeronca	12 mos. Dec. 31	♯$115,300	.....	....	....	$1,710,505	.....
Aircraft Accessories	9 " Jan. 31	290,600	$92,697	$0.21	....	.....	.....
American Airlines	3 " Mar. 31	349,392	71,060	0.51	$0.05	6,342,423	$4,753,472
Aviation Corp	3 " Feb. 28	1,002,844	198,093	0.17	0.04	7,274,968	2,466,600
Bendix	6 " Mar. 31	8,122,679	5,904,862	3.84	2.81	169,633,526	56,415,308
Briggs Mfg	12 " Dec. 31	♯5,510,812	*6,130,881	2.83	3.09	.....	.....
Borg-Warner	3 " Mar. 31	1,867,112	1,617,212	0.80	0.69	.....	.....
Curtiss-Wright	12 " Dec. "	♯25,717,512	*15,746,874	3.15	1.81	373,083,364	138,720,151
Fairchild Aviation	" " " "	♯1,060,981	*648,698	3.14	1.92	.....	.....
Grumman	" " " "	♯1,066,683	*1,415,964	2.10	2.79	21,858,680	8,811,294
Hayes Mfg	3 " Mar. "	73,528	27,863	0.08	0.04	.....	.....
Noorduyn Aviation Ltd.	12 " Dec. "	♯83,539	.....	0.89	....	9,733,300	2,450,000
Northrop Aircraft	3 " Jan. "	282,408	.....	0.78	....	.....	.....
Pan American Airways	12 " Dec. "	♯3,361,252	*2,256,317	1.73	1.19	40,035,153	27,334,116
Square D Co	3 " Mar. "	541,170	633,670	1.23	1.44	.....	.....
Stewart-Warner	" " " "	690,777	381,337	0.54	0.30	5,045,693	2,225,508
T.W.A.	" " " "	L 310,650	L 957,761	....	....	3,113,474	.....

♯ — 1941. * — 1940. L — loss.

ON THE RAW MATERIALS FRONT

THE PRESIDENT'S 1942 war production goals in airplanes, tanks, ship tonnage and guns appears easily within reach as far as plant capacity is concerned. It is now all a matter of available raw materials which the American war machine is consuming in ever increasing amounts. The aircraft industry is running ahead of production schedules but is still somewhat below maximum capacity because raw materials are not flowing in as fast as they can be used. The War Production Board is rapidly cutting down on the civilian use of steel for even the consumers of almost negligible amounts while nickel remains a worrysome bottleneck although its use has been restricted almost 100 percent to war work. So it goes down the list of vital materials.

Aluminum, not so much the raw metal as the forgings and other fabricated parts, remains a trouble spot for the aircraft industry. But here a substitute material, plywood, is coming into its own. North American Aviation, for example estimates that in its advanced training plane, plywood substitutes for 250 lb. of aluminum per unit while Curtiss-Wright is recruiting a group of furniture makers for subcontract work on its new all-plywood cargo plane.

Plywood is made of thin sheets of wood, glued together by a resin with the grain of each layer usually placed at right angles to the grain of the layer below it. The result is a material so strong and adaptable that it is acceptable for various kinds of sheet and corrugated metal. The industry operates 30 plants, mostly in the Far West and had an output of around 150,000,000 sq.ft. last year, as compared with 90,000,000 sq.ft. in 1940. Plant capacity is under expansion and the only limitation on production at present appears to be glue. Phenol, one of the chief glue ingredients, is under allocation for war and essential civilian use. Additional phenol-making capacity will be available this year but, even so, the supply situation probably will be tight for the duration.

Aluminum has been requiring such large amounts of soda ash recently that the glass industry became quite concerned over supplies of this necessary material, especially since the glass container is taking the place of the tin container in so many fields these days. But the situation has been eased by a promise on the part of the soda ash producers to increase production 25 percent, thus assuring enough of this product for both aluminum and glass requirements.

Despite the ambitious expansion plans for magnesium announced in 1941, Dow Chemical Company with its salt brine and sea water extraction process remains the sole producer of this lightest-of-all metals and vital aircraft material. Fortunately Dow has constantly expanded production to meet minimum needs here as well as supplying huge quantities for other United Nations as needed. Trade reports indicate that the government has about written off all hope of attaining magnesium under the process followed by Permanente in its West Coast plant, financed by the RFC at a cost of several million dollars and there is also the unconfirmed report that Permanente officials are negotiating in Washington for permission to make magnesium by the new Canadian process which is quite similar to one which will be employed by Union Carbide & Carbon Corporation in its new magnesium undertaking. Meanwhile Jesse Jones, Secretary of Commerce, estimates that the Basic Magnesium Co. development in a western state will be in production in August and a number of other projects will begin operations later on.

BANTAMITE

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RELAYS by GUARDIAN

★ Swing the turrets! Aim! Fire! And, aircraft guns respond to controls by Guardian. Sight! Bomb! It's the order of the day. Guardian stands ready for any assignment that will help to preserve the "American Way" of life.

Certified by all branches of the war department . . . Guardian invites inquiries for samples of Government Approved Controls for the jobs you are doing today . . . for those new designs that must excel tomorrow. Write—wire—phone.

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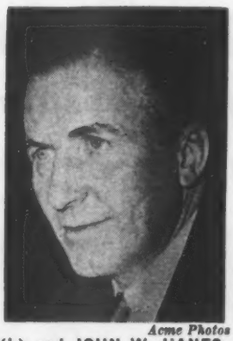
LARGEST LINE OF RELAYS SERVING AMERICAN

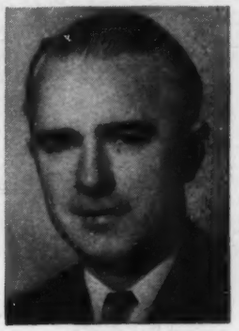


Acme Photos

CHARLES FRANCIS ADAMS (l.) and **JOHN W. HANES**, have been elected to the board of Pan American Airways. Mr. Adams, former Secretary of the Navy is chairman of the advisory committee of the Massachusetts Co. which has substantial holdings in PAA. He is also director of A.T.&T., GE and other companies. Mr. Hanes, former Under Secretary of Treasury, is chairman of executive committee of the U.S. Lines. Other directorates include Bankers Trust, Johns-Manville, Missouri-Kansas-Texas RR. and other companies.

AVIATION'S former editor, **S. PAUL JOHNSTON** has been appointed manager of Curtiss-Wright's Washington office. Mr. Johnston, author of numerous aviation texts and more recently coordinator of research for the NACA, will work closely with Government agencies.

"WALT" ADDEMS becomes UAL's flight director, succeeding R. T. Freng. Walt has been 11 years as chief of flying for United's eastern operations, and his experience goes back to when, at 17, he taught himself to fly in a Curtiss pusher plane. Has logged 1,500,000 miles.



Appointment of **W. C. OSBORNE** as supt. of outside production for Northrop is announced. For past three years he has headed his own firm of industrial engineers. Outside prod. dept. has been moved to a central location so as to work more closely with all suppliers.

PERRY V. OGDEN, newly appointed factory manager and general supt. of Boeing's Seattle plant, is in charge of production of Flying Fortresses. Ogden returns after absence of eight years, coming back from Consolidated where he was production control supervisor.

GEORGE T. CHRISTOPHER is newly elected president and general manager of Packard Motor Car Co. A graduate electrical engineer of Rose Polytechnic Inst., Christopher entered motor car business in 1917, joining Packard in 1934. He has also been elected a director of firm.

GROVER LOENING has resigned as a director of the Platt-LePage Aircraft Corp. in order to be free to develop a helicopter of his own design on which he is now conducting. Mr. Loening believes progress made so far indicates a vast potential in the helicopter field.

Wide World Photos

GEN. ROBERTO FIERRO, head of Mexico's Air Forces, is here to expedite the purchase of engines for trainers. Gen. Fierro made a non-stop flight, first ever made, between New York and Mexico City in 1930. He is also head of the Mexican Wing of the American Escadrille.

JOHN E. ROYALL, executive vice-president of Menasco Mfg. Co., has been elected president of that firm, filling the post made vacant by the resignation of A. E. Shelton. Mr. Royall has been with Menasco since April, 1941, when he accepted post as v.p. in charge of finance.

HARRY R. STRINGER has been elected vice-pres. in charge of traffic, advertising, and public relations of All American Aviation, Inc., Richard C. du Pont, pres., has announced. Stringer joined All American as director of public relations in March, 1939.

HARRY T. ROWLAND, former sales manager for Glenn L. Martin Co., has been elected vice-pres. of the company. He will serve as assistant to Joseph T. Hartson, executive v.p. A native of North Carolina, Mr. Rowland was graduated from West Point in 1923.

L. G. (LARRY) FRITZ, who flew the first load of air mail in commercial service, was given leave of absence from his post as v.p. in charge of operations for Transcontinental & Western Air, for active duty with the Army Air Forces. He'll be chief ops., Ferry Command.

J. W. KUKLA (l.), former director of research and engineering for Aeronca, is the new president of Southern Aviation Mfg. Co., now in Atlanta, and manufacturers of aircraft parts. Mr. Kukla has also been connected in executive positions with Piper Aircraft, Aviation Credit Corp., and Aero Underwriters. Secretary-treasurer of Southern Aviation is **THOMAS W. SUMPTER** (r.), until recently with Vultee in Nashville. He practiced law for six years in Dallas and three years in Nashville, specializing in aviation law.

PILOTS to fight America's future sky battles get thorough training by the U. S. Army Air Forces in this gleaming new Fleetwings basic trainer . . . the world's first military airplane built principally of stainless steel!

Specifications of the BT-12: span, 40 feet; overall length, 29 feet, 2 inches. Powered by a 450 h.p. Pratt & Whitney engine.

This flexible, sturdy ship is just one example of Fleetwings' pioneering. Many new techniques for both fabrication and assembly have been developed by Fleetwings engineers . . . making for higher output per man-hour. *Result:* Fleetwings, the world's leading manufacturer of stainless steel airplanes and structural parts, is keeping ahead of production schedules on vital war contracts for both aluminum-alloy and stainless-steel parts.

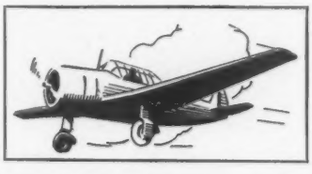
With tomorrow's designs already on its drafting boards, Fleetwings is building planes and parts in ever-increasing quantities, today!

★

FLEETWINGS
Incorporated
BRISTOL • PENNSYLVANIA

NEW BUILDING: Fleetwings is growing faster . . . and far more scientifically . . . than Topsy! Recently, a new plant was added that vastly increases Fleetwings' productive capacity. This new one-story building is 100% blacked-out . . . illuminated with fluorescent lighting, and so designed that it can readily be quadrupled in size. This plant houses the latest "edition" of the straight-line-flow production system that has enabled Fleetwings to keep *ahead of schedule* on warplane wings, control surfaces and hydraulic equipment.

WAR ON WASTE: Every Fleetwings employee has enlisted in the campaign to "Collect Scrap and Beat the Jap!" In each department at Fleetwings are colored containers for the collection of scrap metals of all types . . . a specially colored container for each category of scrap. All scrap is collected daily, baled together and shipped to smelters for reprocessing into virgin metal.



NEW CONVEYOR SYSTEMS: One new Fleetwings' conveyor system now speeds aircraft parts through the painting department, another through the spraying and doping departments. Still another conveyor system has been developed by Fleetwings engineers for automatic degreasing, infra-red-ray drying, and application of primer coats on sub-assembly parts. *Results:* Higher production, better paint coverage, lower cost.

"KEEP 'EM FLYING!"

FLEETWINGS
Incorporated

BRISTOL • PENNSYLVANIA

Recent Books

THE AIRPLANE AND ITS COMPONENTS, *by W. R. Sears, edited by Theodore Von Karman and Clark B. Millikan. Published by John Wiley & Sons, Inc., New York. 71 pages, illustrated. $1.25.*

One of the GALCIT (Guggenheim Aeronautical Laboratory, California Institute of Technology) series, developed from the aeronautical training course given by CIT to graduate non-aeronautical engineers at the request of Lockheed Aircraft Corp. in its expansion program.

Designed as an introduction to aeronautical engineering, it assumes "readers will be engineering students or other persons of some technical knowledge." However, it is so well and clearly written that non-engineers can readily understand and appreciate the material covering aircraft types; external and internal components; radio and instruments; and engines and propellers.

It is an extremely valuable book for anyone entering any phase of the aviation industry.

MACHINE TOOLS IN AIRCRAFT PRODUCTION, *by R. R. Nolan. Published by Pitman Publishing Corp., New York. 156 pages, illustrated. $1.50.*

A practical, basic description of major machine tools used in aircraft production by the superintendent of tooling, Northrop Aircraft, Inc., for vocational students, beginners and young mechanics. Both the functions and the underlying theory of application of the principal tool types essential to mass production are explained, together with a general guide to the analysis of machine-tool requirements.

THE HISTORY OF COMBAT AIRPLANES, *by Charles G. Grey. No. 7 in the James Jackson Cabot Professorship Series. Published by Norwich University, Northfield, Vt. 158 pages, $1.00.*

Three sections of the book cover chronologically the developments to the end of World War I; progress between the two great wars; and the rapid changes of World War II up to mid-1941. A fourth, short section delves into armor and armament and touches on modern combat tactics.

By far the greatest attention is given British aircraft. Mr. Grey, long-time editor of *The Aeroplane*—well remembered for his condemnation of the Boeing B-17—still seems congenitally unable to believe anyone can build or fly anything as well as the English. Possible exceptions are "Mr. Lawrence Bell's *Airacobra*" and the *Airacuda*. Of the latter's non-appearance in combat he says, "Just what the objection to it is I have yet to discover, for in theory it seems one of the finest designs for a twin-motor pursuit ship which has been produced."

Despite pedestrian and, at times, repetitious writing, much of which is admittedly from memory, the book contains a wealth of detail on power, performance and equipment of aircraft leading up to today's combat planes.

TECHNICAL BOOKS—Catalog T-7—*A list of more than 2,200 new and used texts of all publishers, free to "Aviation" readers upon application Dept. E, Barnes & Noble, Inc., Fifth Ave. at 18th St., New York City.*

More than 200 of the titles are in the aeronautical section, one of 27 classifications including blueprint reading; communications; drafting and drawing; electricity; handbooks; industrial engineering; mathematics and tables; mechanics; military science; plastics; power; shop practice and welding.

WHAT THE CITIZEN SHOULD KNOW ABOUT THE AIR FORCES, *by Lt.-Col. Harold E. Hartney. Published by W. W. Norton & Co., Inc., New York. 218 pages, illustrated. $2.50.*

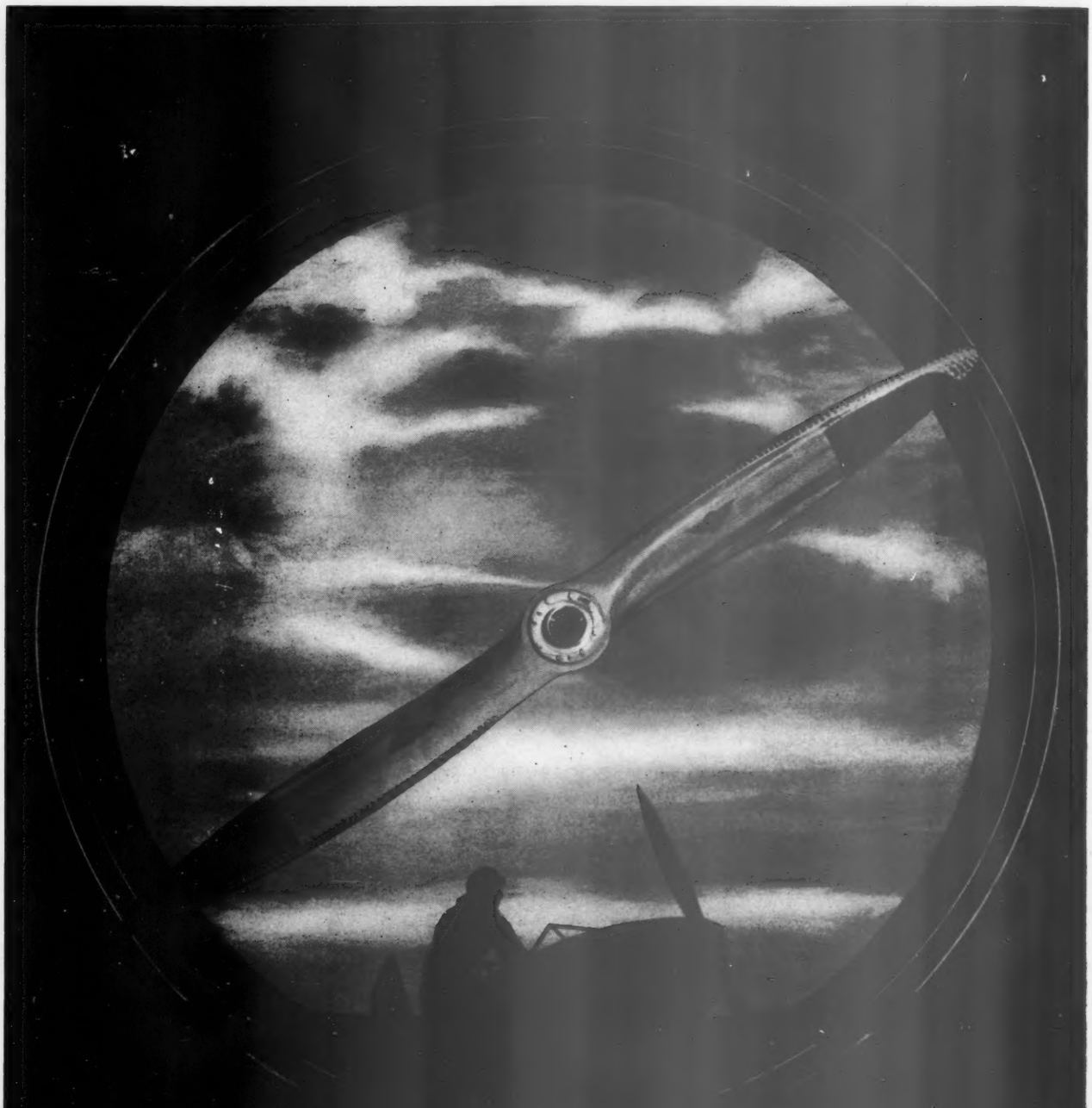
An objective, packed-with-information book with which the civilian may understand the organization and operation of our Air Forces as constituted under the recent reorganization.

Details on the Army Air Forces, for example, include description of the overall organization; training of both officer and enlisted personnel in all the phases now necessary; and organization and functions of the various commands.

WIDER WINGS, *by Patricia O'Malley. Illustrated by Steele Savage. Published by the Greystone Press, New York. $2.00.*

A timely novel continuing the adventures of Carol Rogers as she takes on the inspiring job—and headaches—of organizing an airline stewardess service.

Well written with the technically correct background expected of Miss O'Malley, the story shows the opportunities available in aviation to young women with the right qualities.



SENSENICH Propellers—recognized for their design efficiency, craftsmanship and high performance—are taking a continuously increased part in our Nation's needs.

Accepted as standard equipment in most of the Primary Training planes throughout the Nation, SENSENICH Propellers are serving in a capacity where the utmost in ruggedness and dependability are essential.

SENSENICH's Engineering Staff are keeping abreast of the expanding requirements—both Military and Commercial—in an unceasing effort to produce the best propellers obtainable.

Write Department 'P' for Recommendations, Price List and Pamphlet "Propeller Tips"

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(LANCASTER MUNICIPAL AIRPORT)

LITITZ, PENNSYLVANIA, U. S. A. CABLES: SENSNIK

Women in Slacks

(*Continued from page 75*)

One reason women are doing so well is that airplane manufacturing methods have been changed. To get mass production many operations have been broken down into small components. This has made the operations more repetitive, more monotonous. Ages of sewing, knitting, darning have conditioned women to monotony. Their finger dexterity has been proved superior to that of men. They have more patience.

A foreman at a large bomber plant reports that many young men come to work with notions about plane-building being a romantic business. Put at a machine trimming tiny pieces of metal half a mile from final assembly, they are disappointed and dissatisfied. He has no such trouble with women—they are more realistic, he says. When they have mastered one operation men usually want to move on to something new, but women are satisfied to stick to it, improve their technique, and increase production. "Women don't try to hide their greenness," an instructor at North American said. "They're more eager to learn and they take instruction better."

There's no coddling of women. Out of a dozen aircraft plants visited, from Baltimore to California, I didn't find one that was granting them special favors of any consequence. In some they get 15-min. rest periods, everywhere chairs for certain tasks, but reports of elaborate rest rooms with easy chairs and chintz curtains aren't true. As a matter of fact, lack of ladies rooms is one of the most serious factors holding up the employment of women. This is true not only in old plants but even of plants put up in 1941.

The California plants are pooling their experience with women. For instance, when Douglas found that women tired quickly when operating electric hand drills it consulted other companies. One had the same problem but no answer; another, Vultee, had a solution: a "lazy arm" which supports the drill's weight so that the woman can concentrate on its operation. Douglas ordered lazy arms and got an increase in production.

Douglas personnel men are instructing supervisors in the psychology of handling women. For instance, some foremen unconsciously show favoritism to women—they are put on their guard about that. Others are timid when instruction necessitates physical contact—showing a girl how to grasp a piece of metal or operate a machine. When another company called for a technique on handling a woman worker who talked too much Douglas pulled the answer out of its own experience: isolate her.

Most plants have matrons to whom the women can take their own problems. North American hired a woman Ph.D., who had managed a 50,000-acre ranch, to interview women but first put her through several weeks working at every job for which women are hired. Lockheed, looking to the day when half its employees will be women, has hand-picked a group as potential sub-foremen. They are intelligent women who have had responsibility in other jobs; for example, a sub-foreman with an electric company and a school teacher who became assistant superintendent of schools.

When women are first brought into an all-man plant there are a few chaotic days, horseplay and gaping. But yoo-hooing usually ceases after a few days. When it persisted at the Douglas plant in Santa Monica the girls took the matter in their own hands. After lunch one day 15 of them lined up near the door, waited for the men to come

SUN GLASSES MAY BE ON AN ARMY FLIER NOW....

Because they make eyes comfortable, vision sharp, Bausch & Lomb Ray-Ban Sun Glasses have won top preference among sportsmen, shooters, outdoor enthusiasts. But those are the same reasons why Army and Navy men need Ray-Bans too. B&L production of Ray-Bans, like binoculars and many special optical instruments, is today at an all-time high. But you may have to wait for yours until government requirements are filled.

★

Confidence Rides With The Dawn Patrol

When the Atlantic Patrol thunders into the dawn, the pilots look ahead with confidence in their machines and the fuel that drives their motors. American fuels, like American planes, are built to bring back safely those who fly.

In American refineries, Bausch & Lomb Refractometers are doing their part in making oils and gasolines so efficient and safely dependable. Modern refractometric methods of control speed refining and maintain a greater uniformity and higher quality than ever before.

Optical science—with Bausch & Lomb instruments—is at work helping to strengthen America's front lines. Today, American manufacturers—like the nation's armed forces—turn to precision optical methods for critical analysis, precise measurement, quality control.

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streaming in, and then gave them the works. Some of the girls whistled, some raised their eyebrows, others issued such catcalls as "Tarzan!" and "body beautiful!" The Douglas girls have had no more trouble.

Most personnel men prefer women 25 to 35. They favor those married, and give top rating to the divorced, separated or widowed woman with children to support. Wives of men in service are also high in personnel preferences. In one day Lockheed hired 30 Pearl Harbor widows for whom the Navy was seeking jobs. North American asks every worker on being called into service to hand in the name of his wife, sister or sweetheart—they try to find her a job.

Interviewers are more influenced by the applicant's need to support herself or her family then by talk about helping to win the war. One personnel director explained that girls who come in waving the flag are rarely able to make the adjustment to factory routine. For similar reasons, most personnel men are on guard against the college girls and the woman with an unusually high I.Q. They turn glamour girls down cold —too distracting to the men. When this became known girls began appearing for interviews in unbecoming clothes and without any makeup. Some of the plain-janes in employment lines proved to be veritable starlets when they showed up for work.

At North American they break all these rules. One out of every six girls went to college. Get-acquainted dances are held every week. The best riveter in the shop is a beauty with a B.S. degree in biology. Nearby soldering a fuel gas float is another college graduate who prepared to teach art. And working at her side with an electric hand drill is Mrs. Dossie Deeds who has three sons in the Marines. Mrs. Deeds appeared in the employment office the day after one son was captured at Wake. Asked what she could do, she said: "I've got just little enough sense to believe I can do anything anybody else can, if you'll just give me a few days to catch on."

The Ford bomber plant also welcomes college girls at 75c. an hour starting wage. Most plants start women—the same as men—at 60c. an hour, which with overtime is more than $30 a week. Here and there is a woman who doesn't need her pay and puts it all into defense bonds. In the sheet metal department at Glenn Martin one woman, with children to support, handed her week's pay envelope unopened to the Red Cross.

Most women don't seem to find aircraft factory work as arduous as they expected. Though many plants report that women workers bring an increase in absences, this is partly offset by fewer hangovers. The women don't watch the clocks as closely either. Some plants have made uniforms compulsory, others let the woman wear whatever slacks or overalls they like. A net, snood or scarf is usually required to keep hair out of machinery. Jewelry is taboo, also high heels and open toes. Despite lectures showing the danger from metal slivers some women won't give up open-toed shoes until caught. One plant is still hunting a technique to stop the wearing of wedding rings. But nowhere have women created a serious problem.

Women have filled the gaps in manpower caused by the decision of Selective Service not to give blanket deferments to aircraft workers. In a pinch, one personnel director said, we could run this bomber plant with 85 percent women. Other estimates for specific plants varied between this figure and 50 percent. And in general, the further a plant has gone toward hiring women the further it believes it can go. Women, instead of slowing down production, have sped it up. The aviation industry's experience has proved that women in coveralls can lead the way toward success in the greatest production effort the world has known.

Tank Busters

(*Continued from page* 191)

109 fighter—the latter to defend the bomber from attack by hostile fighters.

Cooperation between the Luftwaffe and the Army was well organized and when the tanks were unable to overcome an obstacle, the dive bombers were called up in sufficient quantities to blast away the opposing position. These tactics served the Nazis well in the European battles of 1939 and 1940, when fighter opposition was insignificant. The Nazis also used the dive bomber to create panic among refugees, mercilessly machine-gunning and bombing them on the roads and so impeding Allied troop movements.

Dive Bomber Limitations

The success of the dive bomber, however, was not repeated, much to the Nazis' surprise, when the same technique was applied to the attack on Britain. Then, a small but highly efficient Fighter Force shot the Junkers 87's out of the sky. This Junkers was then exposed as being limited, in its effectiveness and the most vulnerable of any type of bomber except when local mastery of the air had previously been established by the supporting fighter squadrons.

The next type of bomber tried by the Germans were the small, fast Me. 109's and 110's which were essentially fighters equipped to carry a small bomb load, and by virtue of their speed and fighting power they stood a better chance of getting back to base in safety.

Up to this time Britain had been on the defensive, using her night bombers for strategical purposes only. Now, we begin to hear of fighter sweeps across occupied territory—where Hurricanes and Spitfires shoot up enemy bases, or troop and transport concentrations. This phase is being succeeded by sweeps of day bombers which, guarded by high-flying fighters, are making low-level attacks with very satisfactory results.

The need for unescorted aircraft which can carry bombs, be fast enough to escape with a whole skin, and be well enough armed to fight its way out if necessary is being satisfied with the "Hurri-bomber" — the old Hurricane equipped to carry two 250-lb. bombs and a full load of machine gun ammunition at a speed in excess of 300 mph.

Far better technical use is being made of this airplane than the Nazis had achieved in their use of the fighter-bomber Messerschmitt which flew high and dropped bombs indiscriminately on large targets.

Hurricanes, on the other hand, seldom fly an inch higher than is necessary to clear the French cliffs, trees, houses or power cables in their path. They use every dip in the land, twist in and out of factory chimneys, brush trees with their wingtips, and with the full 1250 hp. roaring from their engines, appear as from nowhere over their targets; bombs are released—with delayed action fuses to allow the plane to escape the blast—and the Hurricane is away home again with another factory or power station left blazing.

The fighter-bomber is being used also against German tanks in Libya in company with the cannon Hurricane—another of the now numerous varieties of this remarkable machine.

Just as the tank has proved itself to be the spearhead of the modern army, it has also been made very clear that it cannot be decisive alone. If tanks do not receive support from their air force, and if that air force is not capable of protecting them from enemy air attack, they can be starved out of fuel and immobilized by bomb or by cannon fire.

Kansas City Airport

(*Continued from page* 202)

now plaguing some defense production areas.

At the same time, the Kansas City area had more than 7,100 housing units available to accommodate a sizeable in-

How to get the MOST out of Control Cords

First of a series of advertisements to familiarize users of control cords with the basic principles of their installation, inspection and care.

AVOID HANDLING IT IN DIRTY PLACES

or allowing it to drag on a gritty floor. It's surprising how much dirt and grit it will pick up, and every bit will contribute to the cable's rapid wear, and shorten its life.

BE SURE YOUR HANDS ARE CLEAN

free of excess dirt and grit before handling control cable. Dirt that comes from hardworking, perspiring hands is even more corrosive than dirt from a floor.

AFTER LUBRICATING CONTROL CABLES

on land planes, be sure to wipe surfaces clean. Dust is no problem in seaplane operation, and that will be discussed in a later message in this space. But any lubricant left on land plane cables merely serves as "flypaper" for airport dust, coating the cable with a gritty, abrasive mixture that promotes rapid wear.

IF you're an old hand at control cables, as Roebling is, this kind of information may seem elementary to you. But remember, this "primer" information is vitally needed by the young fellows who haven't learned in the school of experience. Pass it along to them.

Pass along, also, the hint that a top-quality control cable such as Roebling manufactures is worthy of the most careful all-around handling they can give it. More information to come, in our next message in this space. *Keep'em flying!*

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY • Branches and Warehouses in Principal Cities

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ROEBLING
AIRCRAFT WIRES AND FITTINGS

AIR-MAZE AIR FILTERS help WACO to *"keep 'em flying"*

Longer, with Less Service and Maintenance

The Waco Aircraft Co., along with many other leading aircraft manufacturers, realize the importance of dependable air filter protection against abrasive dust and grit. That is why so many of their planes are equipped with AIR-MAZE Air Filters.

The UPF-7 Waco trainer shown in the above photo, for example, demonstrates the remarkable service records being made daily by Waco planes. Over 1475 flying hours in fourteen months is the remarkable record of this ship with its "Air-Maze Protected" engine. At the last check, only normal reconditioning was needed!

To keep aircraft engines running longer, with greater efficiency and less maintenance, specify AIR-MAZE Aircraft Air Filters. Our engineers—pioneers of aircraft air filters since 1926—will help you solve your air filtration problems.

The latest Development in Aircraft Air Filters

AIR-MAZE TYPE R-72 AIRCRAFT AIR FILTER

Rigid, all-metal construction that resists vibration. Passes greatest volume of dust-free air—with negligible restriction. Permanent because cleanable—*no replacements needed.* Large dust-holding capacity. Unaffected by moisture or temperature changes. Made in all reasonable sizes and shapes. Write for manual.

AIR-MAZE CORPORATION • *General Offices:* **CLEVELAND, OHIO**

Suppliers of Aircraft Air Filters to the Aviation Industry Since 1926

AIR-MAZE

DEPENDABLE AIR FILTERS FOR EVERY APPLICATION

Photo Courtesy Plains Airways

Taperwings for Mexico 1928

F-3's for Cuba 1933

FT Trainers for Venezuela 1940

TO ALL INTER-AMERICAN STUDENTS Waco Extends a Hearty Welcome

We hope the Waco plane in which you will receive your secondary training will be like a "friend from home." Waco airplanes have been in service in Cuba, Central and South America for many years. They are a familiar sight in Brazil where they carry mail to out-of-the-way places . . . in government service in Nicaragua . . . as trainers in Mexico, San Salvador and Guatemala. We want the name Waco to mean more to you than simply a training ship. We try to build Wacos so they will be a symbol of permanent friendship . . . something that will give much and ask little.

To each Inter-American student, we dip our wings—Keep 'Em Flying . . . Happy Landings. WACO AIRCRAFT COMPANY, Troy, Ohio.

Illustrated Above: *Few thrills in flying equal the never-to-be-forgotten first solo in a Waco. Here Americo Varelz of Buenos Aires, Argentina, receives suggestions from Jorge Eulert of La Paz, Bolivia, and Sylvio de Neimeyer Barreira Cravo of Rio de Janeiro, Brazil.*

THE WACO AIRCRAFT COMPANY · TROY, OHIO · U S A

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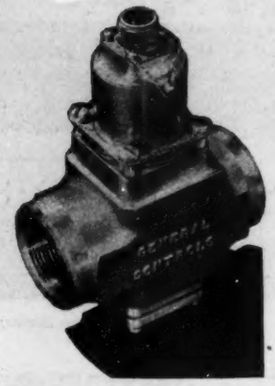
AIRCRAFT TYPE ELECTRIC VALVES

Multipoised—Work in Any Position
Compact—Fast Operating—Light Weight
Resist Vibration and Change of Motion



OIL OR GASOLINE SAFETY SHUT-OFF

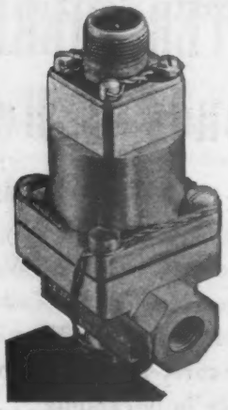
(TYPE AV-12 AT LEFT)

These valves are of the packless, semi-balanced or single-seated, metal-seated type. Available normally open or normally closed, requiring current only to close or open. No integral control switches. Avoid vapor lock. For intermittent duty only. Operate on D.C.—from 6 to 24 volts. Handle oil and gasoline.

FUEL CONTROL TO CABIN HEATERS

(TYPE AV-1 AT RIGHT)

These valves are of the single-seated, metal-seated, two-wire, current failure type. Weigh from less than ½ lb. up. Handle all vapors, vapor mixes, liquids and gases. Operate on D.C. Available for continuous or intermittent duty. Operation unaffected by vibration, mounting position or acceleration.



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flux of new workers. Living costs in the metropolitan area of Kansas City are lower than in any of 21 other large cities listed by the Department of Labor.

Power, natural gas and water supplies are almost unlimited and the city is served by twelve trunk line railroads and three major airlines. Located strategically in the center of the nation, Kansas City is next door to all America.

Here are industrial facilities, to match new airport facilities, which are as tremendous as they are vital to the all-out war effort.

With its new, third municipal airport, Kansas City is virtually unequalled for airport facilities capable of accommodating the vast growth forecast for aircraft manufacturing and air transportation in the future.

Nevertheless, the city's aviation leaders, airline executives, private fliers and city officials are meeting even now to plan, with the advice of CAB engineers, for further expansion of Kansas City's encircling "five airport" system plan, for the days of peace ahead.

Meanwhile, the city is fast emerging as a capital of top rank importance in other phases of aviation.

Twenty-one private and public aircraft and trades schools are keeping step with increasing demands for trained aircraft plant workers and airline maintenance mechanics, sheet metal, welding, aeronautical drafting, radio and television, and aircraft instruments.

Thirty-five firms in Kansas City are engaged in the aircraft industry. These include two major airlines, five manufacturing plants fulfilling large war contracts for military planes (including the all-important B-25), eleven aircraft training schools, five large fixed base operators and many other concerns manufacturing a wide range of aircraft components.

Confident of great things to come in aviation in the years ahead, Kansas Citians today foresee that their airport and aviation preparations of today and their strategic location in the center of the continent will enable them better to serve the needs of their great nation in the future.

Working Plastics

(*Continued from page* 109)

to all edges. It is advisable to leave the patch under light pressure for 24 to 36 hr. and preferably longer before any attempt is made to clean up the patch by filing, sanding, and buffing it to the level of the patched piece.

In patching a curved or a large section where it is not possible to heat the patch, it is possible to obtain a perfect fit by cutting the patch first and using it as a template. The area to be cut out of the damaged piece is indicated by scribe lines. Saw within the scribe lines and sand or file the edges to a smooth 45 deg. taper. With careful workmanship, it will be possible to obtain a good fit.

When the section is curved, the part to be repaired may be used as a form for the patch simply by protecting it with outing flannel or similar soft cloth.

The patch should never be square or have any sharp corners at which strains may develop. An oval or round patch will always prove more satisfactory.

Merlin "Twenty"

(*Continued from page* 207)

coupling to the propeller reduction gear. All other main units, including supercharger, magnetos and camshafts, are driven from the rear end of the crankshaft through a spring drive shaft. The crankshaft is carried in seven gearings, lined with special lead bronze, housed in the top half crankcase.

The connecting rods are H-section steel forgings, machined all over, and are of the forked marine type. The pistons are aluminum forgings and have three pressure rings and two drilled scraper rings. Hardened steel floating gudgeon pins are employed.

The two-speed supercharger used is the centrifugal type which delivers pressures above atmospheric through a large diameter pipe led between the cylinder blocks to the inlet ports in the cylinders. It is driven from the rear end of the crankshaft through clutches by a two-speed mechanism, the gear ratios of which are arranged so that maximum engine power is available at operational heights to meet service conditions. The gear change mechanism for the supercharger is operated by the pilot through a servo cylinder deriving its power from scavenge oil pressure. Maximum operational speed of the supercharger rotor, which is made of an aluminum alloy forging, is said to be about 29,000 rpm.

A comparison between the *Merlin X* of 1938, and the present *Merlin XX*, both of which are equipped with two-speed superchargers, is given as follows:

	Merlin X	*Merlin XX*
Max. power (low gear)	1,130 hp. at 3,000 rpm. at 5,200 ft.	1,260 hp. at 3,000 rpm. at 12,250 ft.
Max. power (high gear)	1,010 hp. at 3,000 rpm. at 17,750 ft.	1,175 hp. at 3,000 rpm. at 21,000 ft.

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MUCH of the speed-up for War Production is dependent upon fast, safe and modern methods for surface cleaning and processing. There is a special TURCO Compound for every industrial surface-processing operation. Check those on the list below, on which you need help. Full information. Free literature. No obligation.

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- ☐ CHROMATIZING
- ☐ CLEANING HEAT EXCHANGERS
- ☐ CLEANING METALS BEFORE PROCESSING
- ☐ CLEANING PRIOR TO PLATING
- ☐ COLD IMMERSION CLEANING
- ☐ COLD SPRAY CLEANING
- ☐ DISHWASHING
- ☐ FLOOR MAINTENANCE
- ☐ GENERAL PLANT MAINTENANCE
- ☐ GLASS CLEANING
- ☐ HOT IMMERSION CLEANING
- ☐ LAUNDERING
- ☐ MAGNESIUM PROCESSING
- ☐ PAINT CAMOUFLAGE CLEANING
- ☐ PAINT DEPARTMENT MAINTENANCE
- ☐ PAINT STRIPPING
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22-62

FACTORIES IN LOS ANGELES AND CHICAGO

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Machine Loading

(*Continued from page* 94)

The particular type of machine load board as used by Bell Aircraft Corporation, consists of a series of boards which are mounted on an upright pedestal, hinged in such a manner as to permit the swinging of one board away from the face of another.

These boards are captioned at the top by a series of dates covering a three month period. On the left-hand side, we list names of the machines involved opposite each machine, and extending the full width of the board are a series of ½ in. holes spaced to represent each working day of the week. This permits a colored rivet to be inserted under any particular date indicating the load condition of any particular machine. Different colored rivets indicate available machine time, overloading, or normal flow. The use of different colors enables machine loading personnel to make a visual survey and readily check available man-hours.

The person in charge of the machine loading is one who is capable of estimating time, who in turn determines the machine hours required when releasing new work to the shop. This time is again checked when time study figures are available. A system for the releasing of parts to the shop is as follows:

The planning engineer receives a blueprint from the engineering department and proceeds to make an operation sheet for each part involved. This is then typed, dittoed, with a copy going to the machine loading group. The estimator in the machine loading group then prepares a card which covers part number, name, type of material and lists the different machines with the estimated time shown, and immediately changes the board to indicate additional work for whatever machines are involved. In cases where the time to complete one part is a fraction of an hour, the board is not changed until an accumulation of these small parts are sufficient to show an appreciable change in direct labor hours.

A daily report is kept by this group which indicates the amount of production time on set-up, rework, repair, tool room, experimental, standard parts, idle time and so on.

This report in itself is a barometer as to whether or not the shop is as efficient and meeting the time set up by the machine loading group. In making this analysis only the men who operate the machines are considered as man-hours used by the machine shop. Trying to keep a machine loading board up to date and include all the personnel in the machine shop which includes top supervision, lead men, bench hands, etc. will result in confused ideas as to the amount of man hours being consumed per ship.

Another factor which enters into the case of trying to keep a uniform flow of work on all machines, is the delivery of material to the shop. There are times when particular jobs are fabricated on the screw machine. The parts require additional operations such as milling, drilling, grinding, lathe work and possibly other screw machine operations, and again quite often the one screw machine operation completes the part. If the latter case presents itself over a two or three day period, there immediately becomes a shortage of work for other types of machinery, which will be overloaded when the flow of work from the screw machines lend themselves to additional operations on other types of machines.

This is an item which has been found most difficult to control, but we are confident that in better planning and more careful scheduling lies an eventual solution.

This method of coordinating control of machine loading also assists us in meeting problems involved in extensive subcontracting of work. Bell Aircraft was a pioneer in aircraft subcontracting and now successfully "farms out" a large volume of work. A study of the machine load board as of any particular date, indicates immediately what type of operations can be sent outside most advantageously, or, conversely, what jobs can be handled in the shop without creating a "bottleneck."

Another consideration interesting to note is that, in normal times, cost of production would determine the point at which it became advantageous to install machinery for a job formerly done on the bench or in a jig. Under existing circumstances, cost of production is secondary to speed of production and the availability of machinery and materials. However, it has been observed that whenever the fastest method of production is found, it is usually the cheapest also.

As an example, we were having difficulties over a retracting hinge fitting for a landing gear. It was a complicated forging involving tolerances to minutes on angles and ten-thousandths of an inch on bore sizes. In addition, there were difficult problems of warping in fabrication.

We were contracting for these outside. On the basis of practical experiments which gave us reliable time data and operational information, it was demonstrated that we could produce these

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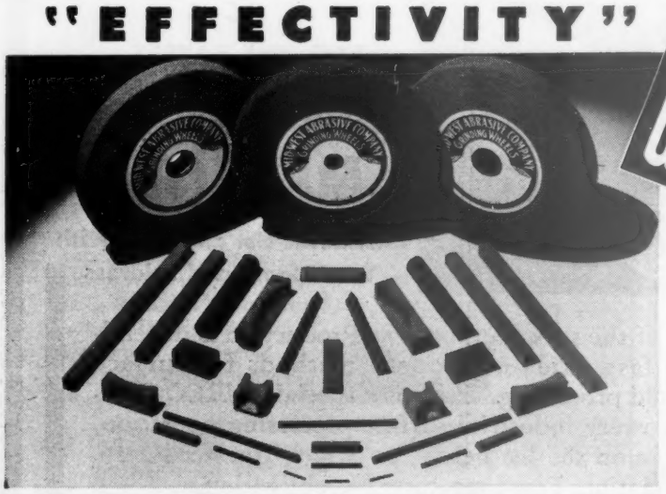

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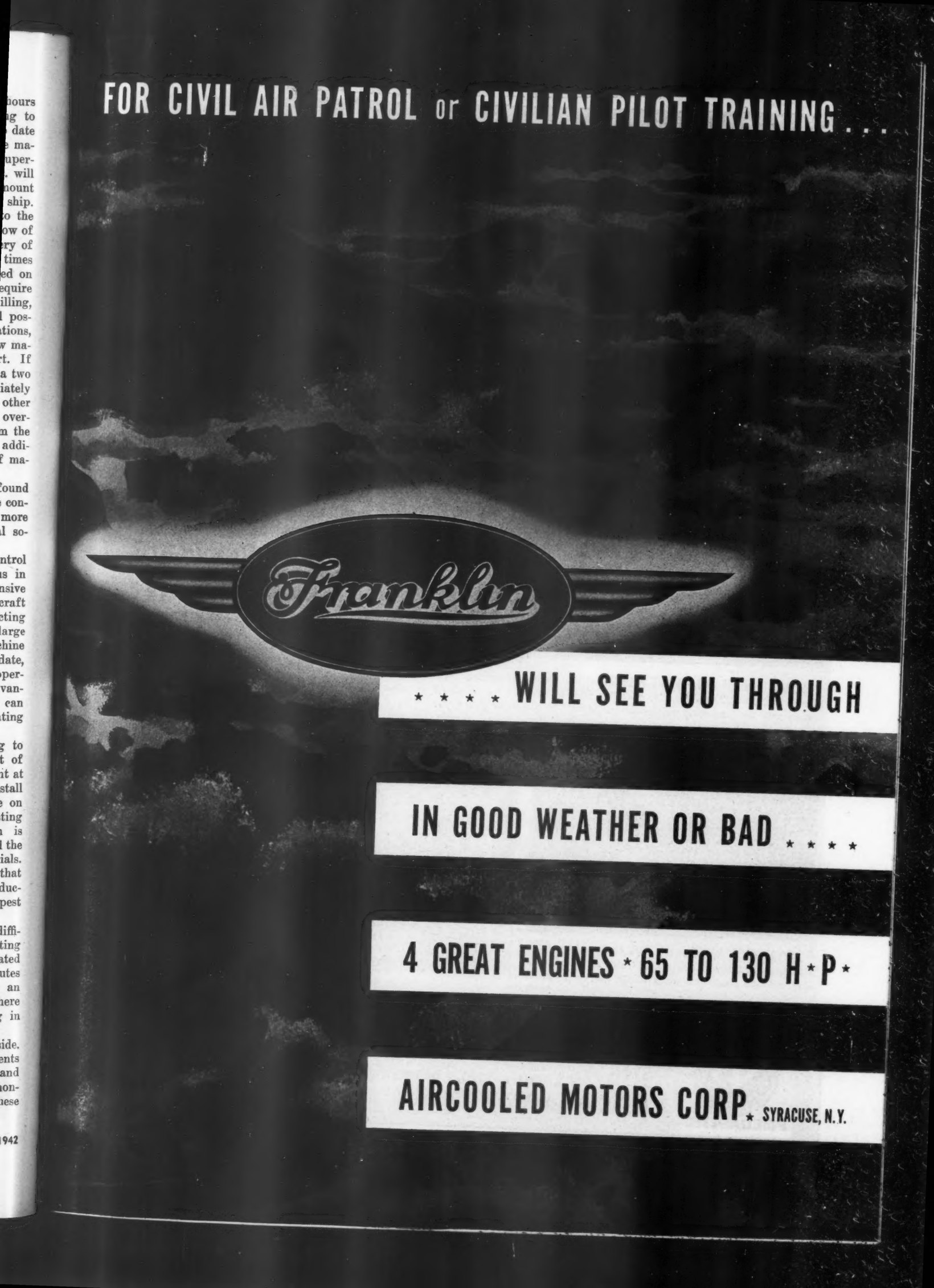
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Interesting example of these special tools is the CP Hicycle Radial Drill which can drill Dural sheets stacked to 5/8" thickness in an overall time of two seconds—including locating and drilling. Write for data on CP Aviation Tools.

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↑ **THE LIGHT WEIGHT AND PERFECT BALANCE** of the Chicago Pneumatic 815 Universal Electric Drill permits over-shoulder operation without fatigue—a particularly valuable feature with the increasing employment of women in the aviation industry. This CP 3/16" electric drill is only one of the most complete line of electric tools for airplane plants.

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↑ **LOWEST MAINTENANCE** of any type of portable tool . . . high sustained speed under load—two of the reasons why aviation plants are going to CP Hicycle Electrics.

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parts in a fraction of the man hours a piece then required, and at a fraction of the cost.

Consequently, we bought a 3½ in. capacity Baker drill, a ½ in capacity Clearman drill press, two No. 3 Cincinnati horizontal milling machines and a used cylinder grinder at a total cost of approximately $20,000.

Now we are producing these parts in 20 percent of the time at a total cost of only 12 percent of the original price. Not only will the new machines have paid for themselves in the course of producing a single order for planes, but they will be available for considerable other shop work as well.

Inter-American Escadrille

(*Continued from page* 214)

What should prove of great value in post-war private flying between the Americas is the fact that all flight training is being based on our CPTP. With funds provided by the coordinator of Inter-American Affairs and working in close cooperation with the CAA, the United States wing is supervising translation into both Spanish and Portuguese of all CPTP handbooks and manuals, a series of some 50 books. It is also expected that permanent coordinators and inspectors will be made available by the CAA for duty in the other countries.

At the same time the Escadrille is taking over the Latin American functions of Air Youth of America, whose United States activities were recently absorbed by the National Aeronautics Association. Here also the United States wing is working with the coordinator's office in having all material translated.

Although the United States wing has been the most active group so far, it is by no means a "ruling group," president Field told AVIATION, pointing out that each country's wing is an autonomous organization. The war killed plans for an international convention, scheduled for either Caracas, Venezuela, or Miami, at which an international governing board was to have been set up and work on the Skyway and elimination of travel hindrances inaugurated.

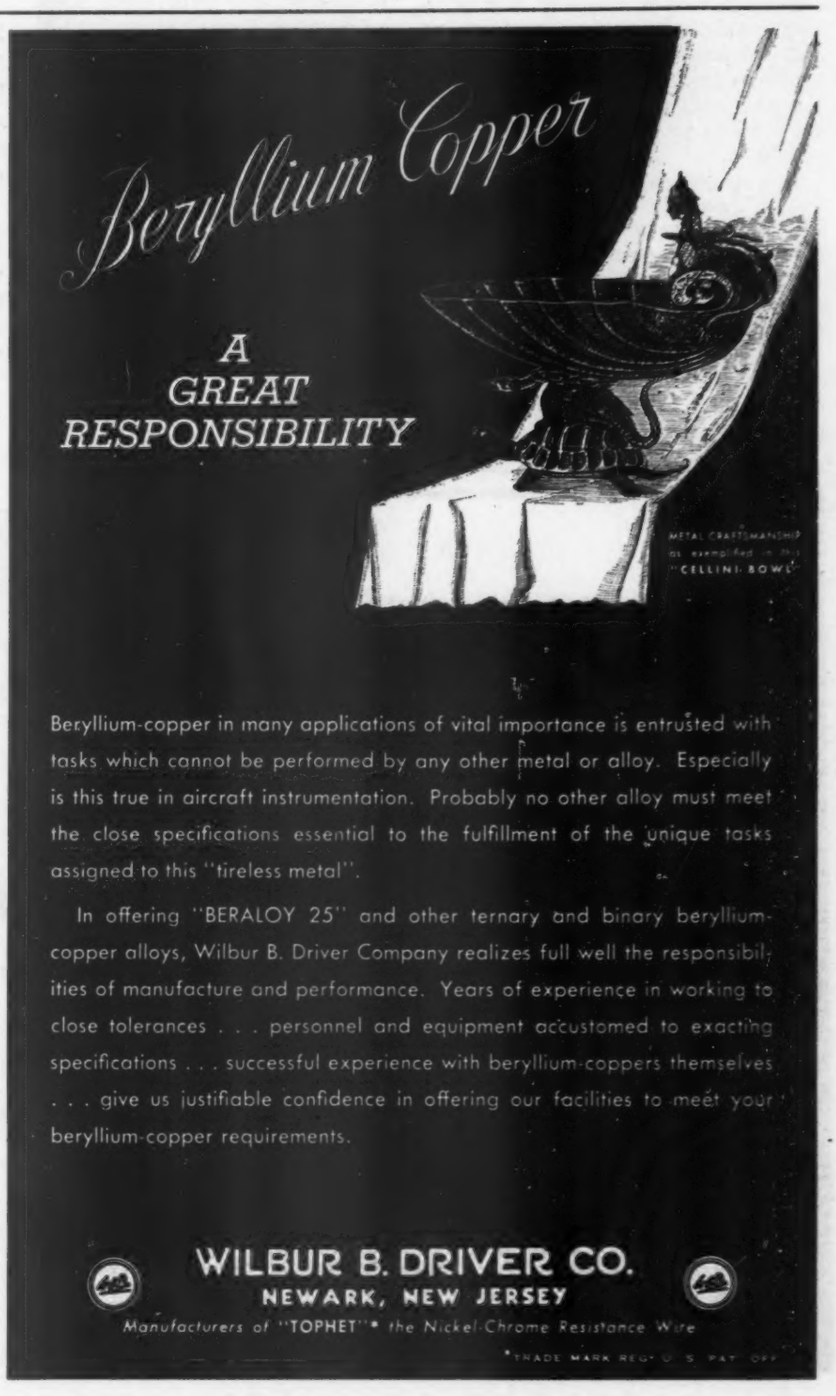
"Until the war is won," Field declared in an interview, "the main activities of the Escadrille must be closely patterned to the war effort. It is doing everything possible to organize and direct defense activities such as air patrols and pilot training, and assisting in the aeronautical education of the youth of the Americas to bring the Western Hemisphere to a high state of aeronautical efficiency.

"These activities are, however, serving as a foundation for the Escadrille's post-war work, when we shall have hundreds of thousands of pilots and tremendous aircraft production facilities. Both will be of inestimable value in the economic development of the American Republics, in many of which the airplane provides the only dependable and speedy means of transportation."

With some of the other activities actually enhanced by the war, completion of the Skyway will not be as difficult as many imagine, Field explained, saying that "to a large extent, it is already a reality."

Numerous intermediate fields along South America's West Coast from Ecuador to Chile are now available, he explained. The terrain of most of Argentina presents no great problem, and small planes today fly from southern Brazil to Rio de Janeiro. From there north to Belem, on the Amazon, planes of the Waco class now make regular flights, and two emergency fields on Marajo Island make it possible for light planes to cross the Amazon.

Most remaining work to be done, he said, is in the northern part of the continent, particularly in Colombia where much of the country is mountainous.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Manufacturers of "TOPHET"* the Nickel-Chrome Resistance Wire
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America At War

(*Continued from page* 73)

low they couldn't see their hits. All they saw at the time were the ships making away. Every improvement in the weight and action of air-borne guns and bombs darkens the picture for surface war ships. Not that war over the water will be any nicer than it is *on* the water.

European Air War

Aside from the Russians' punching back at Hitler on the battleline, the next most decisive action in Europe is England's dishing it back to Germany and occupied countries with more and bigger bombs. The Luftwaffe is still in the ring, with a lot of good fight left, but its heels are down and its breathing is labored.

Now if you live and watch closely, you will see whether airplanes can do what people thought they could do before this war started. Namely, can they render an area untenable and occupy it, or make occupation by land forces bloodless.

The Germans tried it on England, with everything they had, and it wasn't quite enough. RAF officers now say that no more than 1,000 planes ever came over England in any one day. They say the Germans probably never had over 15,000 on their lines at any time, perhaps 25,000 total. England probably has more than that, and certainly will have *many* more, with Lend-Lease planes and Army Air Forces at their aid.

RAF sweeps are made with around 300 planes or more, carrying 4,000 lb. bomb as compared with 500 and 1,000-lb. loads early in the war and during the big German blitz. Furthermore, a pound of explosive is much stronger now than it was only recently. An average of 250 tons of explosive have been dropped on the Reich each raid night since the return blitz started. About 350 tons fell on Lubeck. Estimates differ, but it is said that the Luftwaffe only twice unloaded as much as 400 tons of bombs on Britain in a single night.

Pictures released by the Germans, showing the ruins of Lubeck after the British raid, showed a curious quirk of the Nazi mind. The caption said that Germany would remember England for this job.

Another recent ruinous attack by the British was on Rostock and Germany's Heinkel airplane works, where the Nazis seemed to be about to put into production a new four-engine bomber. This project was halted for the time being by four successive night attacks by RAF. Germany has its new Focke-Wulf fighter in the air, and the English have been meeting up with it over the Channel of late.

At the first demonstration of the new *Whirlwind* fighter, the claim was made that it passes the *Spitfire* in speed. A flight-commander says that *Whirlwinds* have been engaged in operational flying over the English Channel for some time and had destroyed at least 30 aircraft on the ground and in the air since last June.

Closing notes: British air force and naval officers are exchanging tours of duty for experience; the Germans have been doing it for years.

The Russians put an extra piece of armor plate behind the pilot's back and head when they took delivery of some *Hurricanes*. They also added an oxygen feed gadget.

It looks now as if the Russians had paid dearly for their decision to fight through the winter; they are seriously in need of planes. But their air force is in no state of decimation. Correspondents traveling over the country report it very much in evidence. Russia is getting planes from both the United States and England.

New German Bomber

Unofficial reports say that Germany is producing a new Junkers bomber, believed to be the Junkers Ju288, with two new Junkers liquid-cooled engines of about 2,000 hp. each. They are also experimenting with bombers with pressure cabins. It is believed a Junkers transport airplane is being made for carrying light tanks in the fuselage. The tail portion swings on hinges to uncover the hatchway and the tank is run aboard.

The German four-engined Heinkel He177 has the appearance of being equipped with two radial engines, but actually each nacelle houses a pair of liquid-cooled in-line plants. Wing span is 103 ft. 4 in. and top speed is about 280 mph.

First air fight has occurred over United States-held Iceland, between a German and a Norwegian plane. The German was hit but it went into a bank of cloud.

Unofficial estimates are that American pilots and AA gunners have knocked down 715 Japanese planes and damaged others: Navy, 120; Army, 295; American Volunteer Group, 300.

Press reports refer to a Japanese *zero* fighter as hitting an American medium bomber with machine gun *and cannon* fire.

Britain's Air Secretary Sir Archibald Sinclair says that up to new year, 1942, RAF had lost 3,981 planes; Germany 6,440; and Italy 2,119.

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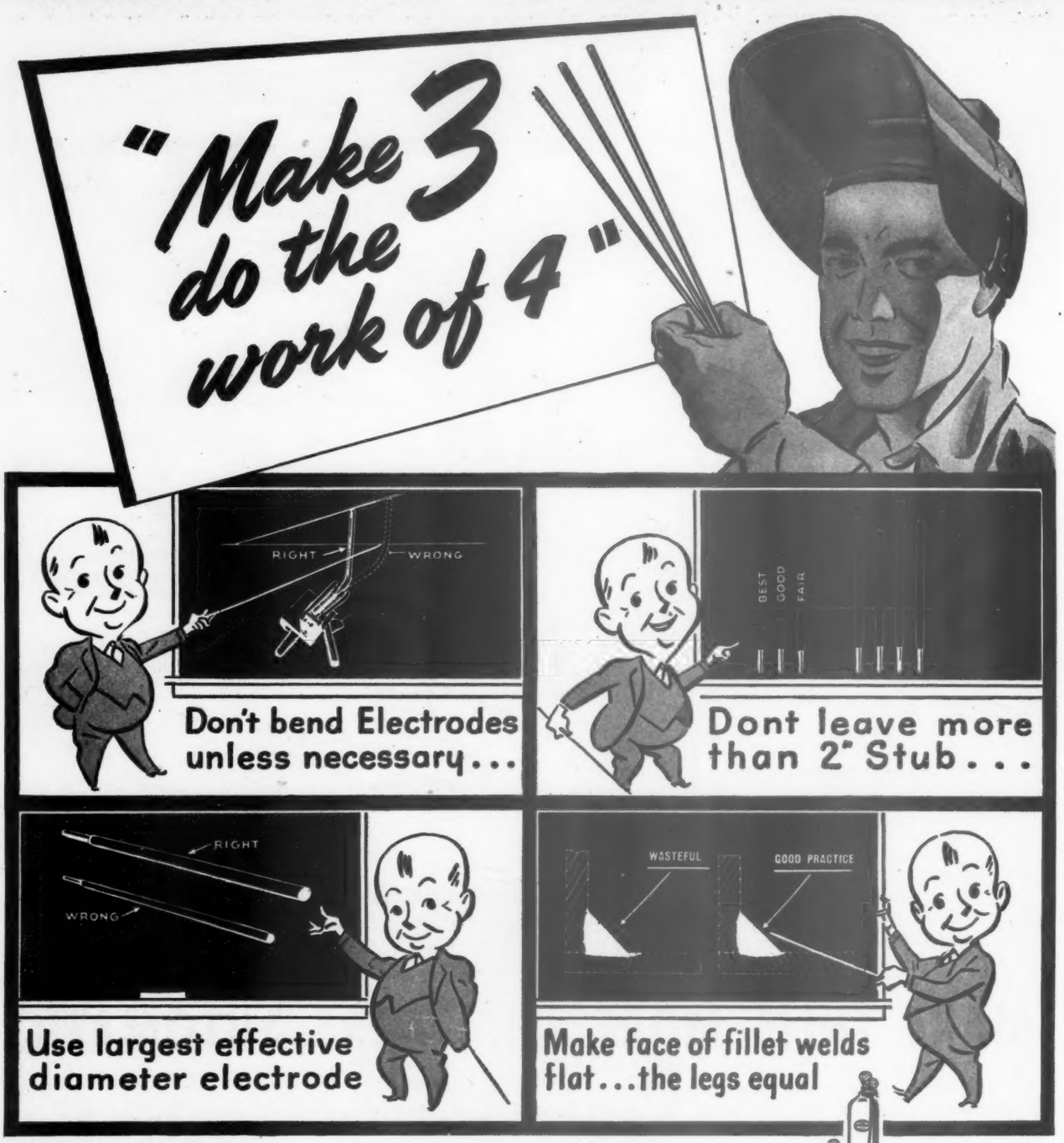

A booklet of shop bulletins illustrating "'do's' and 'don'ts'" has been prepared. We'll gladly send you as many copies as you can use.

We can all prevent waste of valuable welding electrodes by following these and other simple, common sense suggestions. 25% to 30% more welding can, and must, be obtained from available electrodes.

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In Texas: Magnolia-Airco Gas Products Co.

IDLE CYLINDERS ARE PRODUCTION SLACKERS: KEEP 'EM ROLLING FOR VICTORY!

Radio

(*Continued from page* 189)

case. In several instances, close-ups of radio equipment is included with the picture of a ship.

The balance of the booklet is equally informative, including a two-page skeleton blueprint of a typical ship showing all the places connectors can be used to advantage, photographs and text showing the method of installing and wiring connectors, data on the various types of connectors Cannon makes and some interesting shots showing typical connectors in process of manufacture.

Forged Cylinder Head

(*Continued from page* 117)

and consequently much better cooling. Cooling is further improved by a 35 percent increase in the conductivity of the metal.

This improved cooling permits prolonged operation of the engine at rated horsepower at low altitudes, a distinct asset in desert and tropical warfare. Moreover, with the increased cooling facilities, engines can achieve greater power at considerably higher altitudes.

The forged head technique allows the enlargement and improvement of intake and exhaust ports, contributing not only to increased engine output but to decreased fuel consumption, which extends the range so important in current military warfare.

Hand-in-hand with the design of a forged head which lends itself to high production methods went the development of machine tools making it possible to turn out these heads in mass production faster and at costs below those of the cast heads. The final solution of the production problem was achieved by the development of new machines for cutting the fins. These machines were designed to operate at cutting speeds hitherto unthought of in production, speeds approaching those of woodworking operations. Tooling for the cutting operations was worked out in such manner that all other high production machines hitherto used on cylinder heads are still applicable.

Air Hammer Test Stand

(*Continued from page* 186)

on two separate gages. The force gage is calibrated to 200 lb. and the blows per minute gage 0-5000 bpm. After the tool is given this test, and the results compared with the manufacturers' specifications, the mechanic can make the necessary service adjustments or repairs to bring it up to original specifications—and during these adjustments tests can be made to observe the results.

The Burklyn test stand is designed primarily for aircraft types of rivet hammers, capable of driving aluminum rivets up to 7/16 in. dia. and soft iron or dual rivets up to $\frac{3}{8}$ in. dia., requiring a maximum of 40 cu. ft. per min. of air. For larger hammers, flow meters and force gage of greater capacities may be provided and adapters used for the larger size rivet sets.

A unique method of holding the air hammer in position for testing and a means of applying the correct amount of initial pressure on the rivet set is provided with the use of an elastic strap, and a novel gage setting device. A Hanson "Push-Tite" coupling on the front of the cabinet is used for connecting air to the hammer.

The cabinet of the Burklyn Air Hammer Test Stand is provided with a drawer for tools and spare parts, and two larger compartments with doors for storage space of tools to be repaired, overhauled tools, etc. Construction of the cabinet is of wood and plywood, with masonite or similar material for the work bench and instrument panel.

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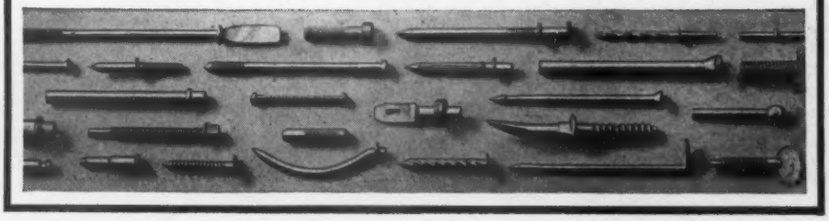

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